PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-004442

(43)Date of publication of application : 12.01.2001

(51)Int.CI. G01J 1/04
B81B 1/00
B81C 1/00
G02B 1/11
G02B 3/00
G02B 5/02

(21)Application number : 11-180250

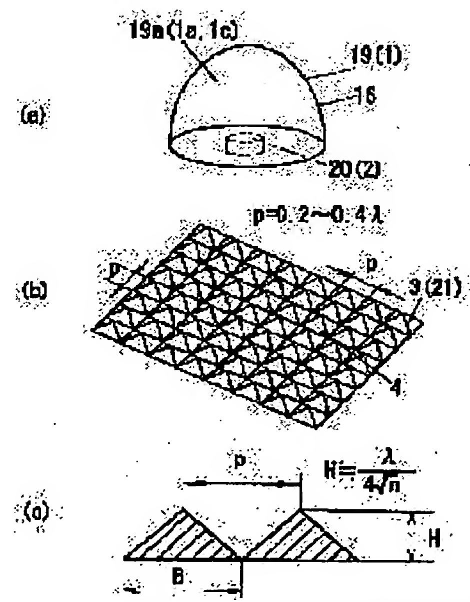
(22)Date of filing : 25.06.1999

(71)Applicant : MATSUSHITA ELECTRIC WORKS LTD

(72)Inventor : FUKUSHIMA HIROSHI
NAKADA MASAAKI
ASAHI NOBUYUKI
UCHIDA YUICHI

(54) INFRARED SENSOR AND ITS MANUFACTURE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an infrared sensor, which can be improved in sensitivity by being equipped with an infrared-ray transmission part having larger infrared- ray transmissivity than a conventional article and also can be manufactured at low cost, and its manufacture.
SOLUTION: This infrared sensor is equipped with an infrared-ray transmission part 1 and an infrared-ray detection part 2 which are made of a transmission cover 19 and then the external surface 1c of the infrared-ray transmission part 1 are formed into an uneven surface 4 by providing projection parts 3, whose height H is nearly 1/(4n1/2) time as large as the infrared-ray wavelength λ used by the infrared-ray transmission part 1, on the external surface 1c at pitch P which is 0.2 to 0.4 time as large as the infrared-ray wavelength λ in use, where (n) is the refractive index to the infrared-ray wavelength A.



LEGAL STATUS

[Date of request for examination] 24.12.2002

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] The infrared sensor characterized by to have prepared heights which are abbreviation 1 / (4n1/2) twice the infrared wavelength which height uses in external surface of the infrared transparency section on wavelength 0.2 to 0.4 times the pitch of infrared to be used, and to make external surface of the infrared transparency section into a concavo-convex field when a refractive index to infrared wavelength which the infrared transparency section uses was set to n in an infrared sensor equipped with the infrared transparency section and an infrared detecting element.

[Claim 2] An infrared sensor according to claim 1 characterized by having prepared heights in a rear face of the infrared transparency section as well as the surface, and making front reverse side both sides of the infrared transparency section into a concavo-convex field.

[Claim 3] An infrared sensor according to claim 1 or 2 characterized by performing water-repellent processing to external surface of the infrared transparency section.

[Claim 4] An infrared sensor according to claim 1 to 3 characterized by being the infrared radiation of a range whose infrared wavelength to be used is 5-15 micrometers.

[Claim 5] the manufacture method of the infrared sensor characterized by to have looked like [the external surface of a material which has photosensitivity and infrared permeability] further the globular form particle of homogeneity particle size which has infrared permeability, to have covered it with it, to have formed a particle layer, and to form a concavo-convex field in the external surface of the infrared transparency section which arranges in an optical path which results in an infrared detecting element by removing this particle layer after exposing the external surface of a material from the outside of a particle layer by making this particle layer into a lens array.

[Claim 6] Resemble further external surface of a material which mixes two kinds of equal globular form particles, and has photosensitivity and infrared permeability, cover it, and a particle layer is formed. the abbreviation for particle size whose another side one side has permeability to a certain light, and has absorptivity -- A manufacture method of an infrared sensor characterized by forming a concavo-convex field in external surface of the infrared transparency section arranged in an optical path which results in an infrared detecting element by removing a particle layer after exposing external surface of a material through this particle layer with said light.

[Claim 7] the abbreviation for particle size, after resembling further external surface of a material which mixes two kinds of equal globular form particles, and has photosensitivity and infrared permeability, covering it and forming a particle layer By removing a globular form particle which remained, after removing only a globular form particle of either of two kinds of globular form particles and performing ablation processing to external surface of a material by using a globular form particle which remained as a mask A manufacture method of an infrared sensor characterized by forming a concavo-convex side in external surface of the infrared transparency section arranged in an optical path which results in an infrared detecting element.

[Claim 8] A manufacture method of an infrared sensor characterized by forming a concavo-convex side in external surface of a material which has infrared permeability by precision cutting by diamond tool.

[Claim 9] A manufacture method of an infrared sensor characterized by forming a concavo-convex field in external surface of the infrared transparency section arranged in an optical path which results in an

infrared detecting element by removing this globular form particle after making external surface of a material spray and fix a globular form particle of homogeneity particle size in the condition of having heated external surface of a material which has infrared permeability, and having made it softening.
[Claim 10] A manufacture method of an infrared sensor characterized by forming a concavo-convex side in external surface of the infrared transparency section arranged in an optical path which results in an infrared detecting element by producing metal mold which imprinted a concavo-convex field by considering as a master the infrared transparency section manufactured in a manufacture method of an infrared sensor according to claim 5 to 9, and carrying out fabrication using this metal mold.
[Claim 11] Produce a master mold of a three-dimension configuration, fill a thing which made a solution which added a binder distribute a globular form particle of SiO2 in a master mold, and a globular form particle of SiO2 is made to deposit. A material which heats a sediment which was made to dry this and remained, produces a mold by removing a master mold after removing a binder and making it solidify, and has infrared permeability using this mold by carrying out fabrication A manufacture method of an infrared sensor characterized by forming a concavo-convex side in external surface of the infrared transparency section arranged in an optical path which results in an infrared detecting element.
[Claim 12] A manufacture method of an infrared sensor characterized by forming a concavo-convex side in external surface of the infrared transparency section arranged in an optical path which results infrared permeability in an infrared detecting element by carrying out hot press to external surface of a material which it has in a mold produced in a manufacture method of an infrared sensor according to claim 11.
[Claim 13] A manufacture method of an infrared sensor characterized by to form a concavo-convex side in external surface of the infrared transparency section arranged in an optical path which results in an infrared detecting element by producing metal mold which had infrared permeability, formed a concavo-convex field in external surface of a material, and imprinted a concavo-convex field by considering this material as a master by crystal orientation etching a material of a field (111), and carrying out fabrication using this metal mold.
[Claim 14] A manufacture method of an infrared sensor which carries out fabrication of the film which has infrared permeability with metal mold or a mold produced in a manufacture method of an infrared sensor a publication by either of claims 10, 11, and 13, and is characterized by forming a concavo-convex side in external surface of the infrared transparency section arranged in an optical path which results in an infrared detecting element by sticking on external surface of a material which has infrared permeability.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] Especially this invention relates to a component and its manufacture methods, such as transparency covering used as the infrared transparency section of an infrared sensor, and a transparency aperture of an infrared detector, about the manufacture method of an infrared sensor and an infrared sensor.
[0002]
[Description of the Prior Art] An infrared sensor is a sensor which can detect the infrared radiation emitted from the body by non-contact, and, generally an infrared detector and this consist of wrap transparency coverings. In recent years, with the miniaturization of an infrared detector, the size of the whole sensor becomes small and transparency covering which is the infrared transparency section, and the transparency aperture of an infrared detector are also miniaturized. For this reason, the sensitivity which detects feeble infrared radiation to an infrared detector is required, and transparency covering which is one infrared transparency section, and the transparency aperture of an infrared detector are required to penetrate infrared radiation efficiently. These conditions are fulfilled and the infrared detector which converges infrared radiation on the infrared light sensing portion of an infrared detector efficiently by the micro lens further, and its manufacture method are indicated by JP,9-113352,A. However, in manufacture of the micro lens which is the infrared transparency section, since this needed the complicated manufacturing process using etching, a photolithography, etc., it was what cost requires very much.
[0003] On the other hand, the method of fabricating transparency covering by resin is mentioned as a method of holding down the infrared transparency section to low cost more. The infrared permeability t is [as opposed to / for example, / infrared radiation with a wavelength of 10 micrometers / in 1mm in thickness] however, very as low about 34% as about 20%, even if the infrared permeability t is high polyethylene in the case of resin at 3mm in thickness about 55% in 2mm in thickness. For this reason, when making the infrared permeability t high, it is necessary to make thickness of transparency covering thin as much as possible. However, since a certain amount of reinforcement was also required of transparency covering, the thickness of transparency covering had become a neck on layout of an infrared sensor. And although how to consider as the means which makes thickness of this transparency covering thin, and constitute the lens section of transparency covering from a Fresnel lens is also considered, in the case of a minute Fresnel lens, depending on that configuration, condensing effectiveness may fall to reverse.
[0004]
[Problem(s) to be Solved by the Invention] It aims at offering the infrared sensor which it can succeed in this invention in view of the above-mentioned point, it can be conventionally equipped with the infrared transparency section with high infrared permeability compared with elegance, and can raise sensitivity, and can be manufactured by low cost, and its manufacture method.
[0005]
[Means for Solving the Problem] If a refractive index to the infrared wavelength lambda which the infrared transparency section 1 uses is set to n in an infrared sensor equipped with the infrared transparency section 1 and the infrared detecting element 2, an infrared sensor concerning claim 1 of this invention It is characterized by having formed the twice as many 1/(4n1/2) heights 3 of the abbreviation for the infrared

wavelength lambda which height H uses for outside 1c of the infrared transparency section 1 as this on the wavelength lambda 0.2 to 0.4 times the pitch P of infrared to be used, and making outside 1c of the infrared transparency section 1 into the concavo-convex side 4.

[0006] Moreover, in addition to a configuration of claim 1, an infrared sensor concerning claim 2 of this invention forms heights 3 in rear-face 1b of the infrared transparency section 1 as well as surface 1a, and is characterized by making front reverse side both sides 1a and 1b of the infrared transparency section 1 into the concavo-convex field 4.

[0007] Moreover, in addition to claim 1 or a configuration of 2, an infrared sensor concerning claim 3 of this invention is characterized by performing water-repellent processing to outside 1c of the infrared transparency section 1.

[0008] Moreover, in addition to a configuration of claim 1 thru/or either of 3, an infrared sensor concerning claim 4 of this invention is characterized by being the infrared radiation of a range whose infrared wavelength lambda to be used is 5-15 micrometers.

[0009] Moreover, a manufacture method of an infrared sensor concerning claim 5 of this invention Look like [outside 6c of a material 6 which has photosensitivity and infrared permeability] further the globular form particle 5 of homogeneity particle size which has infrared permeability, cover it with it, form the particle layer 7, and this particle layer 7 is made into the lens array 8. After exposing outside 6c of a material 6 from an outside of the particle layer 7, it is characterized by forming the concavo-convex side 4 in outside 1c of the infrared transparency section 1 arranged in an optical path which results in the infrared detecting element 2 by removing this particle layer 7.

[0010] Moreover, a manufacture method of an infrared sensor concerning claim 6 of this invention Resemble further outside 6c of a material 6 which mixes two kinds of equal globular form particles 5a and 5b, and has photosensitivity and infrared permeability, cover it, and the particle layer 7 is formed. the abbreviation for particle size whose another side one side has permeability to a certain light, and has absorptivity -- After exposing outside 6c of a material 6 through this particle layer 7 with said light, it is characterized by forming the concavo-convex field 4 in outside 1c of the infrared transparency section 1 arranged in an optical path which results in the infrared detecting element 2 by removing the particle layer 7.

[0011] Moreover, a manufacture method of an infrared sensor concerning claim 7 of this invention the abbreviation for particle size, after resembling further outside 6c of a material 6 which mixes two kinds of equal globular form particles 5c and 5d, and has photosensitivity and infrared permeability, covering it and forming the particle layer 7 Only globular form particle 5c (5d) of either of two kinds of globular form particles 5c and 5d is removed. By removing 5d (5c) of globular form particles which remained, after performing ablation processing to outside 6c of a material 6 by using 5d (5c) of globular form particles which remained as a mask It is characterized by forming the concavo-convex side 4 in outside 1c of the infrared transparency section 1 arranged in an optical path which results in the infrared detecting element 2.

[0012] Moreover, a manufacture method of an infrared sensor concerning claim 8 of this invention is characterized by forming the concavo-convex field 4 in outside 16c of a material 16 which has infrared permeability by precision cutting by diamond tool 17.

[0013] Moreover, a manufacture method of an infrared sensor concerning claim 9 of this invention After making outside 16c of a material 16 spray and fix the globular form particle 18 of homogeneity particle size in the condition of having heated outside 16c of a material 16 which has infrared permeability, and having made it softening, by removing this globular form particle 18 It is characterized by forming the concavo-convex side 4 in outside 1c of the infrared transparency section 1 arranged in an optical path which results in the infrared detecting element 2.

[0014] Moreover, a manufacture method of an infrared sensor concerning claim 10 of this invention By producing the metal mold 9 which imprinted the concavo-convex field 4 by considering as a master the infrared transparency section 1 manufactured in a manufacture method of an infrared sensor according to claim 5 to 9, and carrying out fabrication using this metal mold 9 It is characterized by forming the

concavo-convex side 4 in outside 1c of the infrared transparency section 1 arranged in an optical path which results in the infrared detecting element 2.

[0015] Moreover, a manufacture method of an infrared sensor concerning claim 11 of this invention Produce the master mold 12 of a three-dimension configuration, fill a thing which made the solution 10 which added a binder distribute the globular form particle 11 of SiO2 in a master mold 12, and the globular form particle 11 of SiO2 is made to deposit. The material 16 which heats the sediment 13 which was made to dry this and remained, produces a mold 35 by removing a master mold 12 after removing a binder and making it solidify, and has infrared permeability using this mold 35 by carrying out fabrication It is characterized by forming the concavo-convex side 4 in outside 1c of the infrared transparency section 1 arranged in an optical path which results in the infrared detecting element 2.

[0016] Moreover, a manufacture method of an infrared sensor concerning claim 12 of this invention is carrying out hot press of the mold 35 produced in a manufacture method of an infrared sensor according to claim 11 to outside 16c of a material 16 which has infrared permeability, and is characterized by forming the concavo-convex field 4 in outside 1c of the infrared transparency section 1 arranged in an optical path which results in the infrared detecting element 2.

[0017] Moreover, a manufacture method of an infrared sensor concerning claim 13 of this invention By having infrared permeability and crystal orientation etching the material 14 of a field (111) 37 By forming the concavo-convex field 4 in outside 14c of a material 14, producing the metal mold 9 which imprinted the concavo-convex field 4 by considering this material 14 as a master, and carrying out fabrication using this metal mold 9 It is characterized by forming in the concavo-convex side 4 at outside 1c of the infrared transparency section 1 arranged in an optical path which results in the infrared detecting element 2.

[0018] Moreover, a manufacture method of an infrared sensor concerning claim 14 of this invention Fabrication of the film 15 which has infrared permeability with metal mold 9 or a mold 35 produced in a manufacture method of an infrared sensor a publication by either of claims 10, 11, and 13 is carried out. It is characterized by forming the concavo-convex side 4 in outside 1c of the infrared transparency section 1 arranged in an optical path which results in the infrared detecting element 2 by sticking on outside 16c of a material 16 which has infrared permeability.

[0019]

[Embodiment of the Invention] The gestalt of operation of this invention is explained based on drawing 1 thru/or drawing 13 .

[0020] An example of the gestalt of operation of this invention is shown in drawing 1 . This infrared sensor mainly consists of transparency covering 19 which is the infrared transparency section 1 as shown in drawing 1 (a), and an infrared detector 20 which is the infrared detecting element 2. In addition, the transparency covering 19 is formed by resin with the high infrared permeability t, such as polyethylene. As stated above, the sensitivity which detects feeble infrared radiation is required of an infrared sensor with the miniaturization, and, speaking of the infrared transparency section 1, it is asked for improvement in the infrared permeability t. Then, the concavo-convex field 4 as shown in drawing 1 (b) is given to surface 19a of the transparency covering 19 of the infrared sensor of this invention, and improvement in the infrared permeability t is in drawing. This will reduce the reflective loss at the time of infrared radiation carrying out incidence to the transparency covering 19, i.e., the rate of the infrared radiation reflected by surface 19a of the transparency covering 19 in the transparency covering 19, without carrying out incidence. This reflective loss is decided by the refractive index n to the infrared wavelength lambda which the material 16 used for the transparency covering 19 uses, and a reflective loss also becomes large, so that the refractive index n to the infrared wavelength lambda to be used is large. Therefore, if a refractive-index difference with air (refractive-index na=1) makes it a small interface, a reflective loss will decrease and the infrared permeability t will improve. the infrared wavelength lambda which uses the heights 3 of the **** rectangular-head drill 21 to which the concavo-convex field 4 shown in drawing 1 (b) is set to surface 19a of the transparency covering 19 from a certain fixed proportion -- receiving -- the pitch P of a certain fixed ratio -- with -- **** -- it constitutes continuously. As a concrete indicator which specifies this concavo-convex side 4 It is set as the value within the limits of 0.17 to 0.23 times of the infrared

wavelength lambda which uses height H of the **** rectangular-head drill 21 first (when the refractive index n to the infrared wavelength lambda which a material 16 uses is set to 1.5). Next, it is determined that a pitch P will become within the limits of 0.2-0.4lambda to the infrared wavelength lambda which a pitch P (it is equivalent to length B of the base of the **** rectangular-head drill 21) uses. Thus, a refractive index n serves as an interface which changes continuously, in this interface, since a refractive-index difference with air changes gradually, a reflective loss can reduce the concavo-convex field 4 formed by constituting continuously the heights 3 of the **** rectangular-head drill 21 specified, and it can raise the infrared permeability t. In addition, the infrared wavelength lambda which actually uses this effect is [height H] 2 micrometers to 10 micrometers. As opposed to the infrared permeability t of the ordinary polyethylene board which does not give this concavo-convex side to the surface having been 16% when examined by giving the concavo-convex field in which a pitch P is formed by constituting continuously the **** rectangular-head drill which is 3.2 micrometers to the surface of a polyethylene board The infrared permeability t became 19.5%, and the direction of the polyethylene board which gave the concavo-convex side to the surface was checked also when the infrared permeability t improved 3.5%. Moreover, even if the concavo-convex side 4 is formed on a curved surface, it is possible to acquire the same effect. For example, in the case where the concavo-convex field 4 is constituted from a curved surface where the ridgeline of a curved surface has a sinusoidal form, since the amplitude of a sine wave is equivalent to height H of the above-mentioned **** rectangular-head drill 21 and the period of a sine wave is equivalent to length B (= pitch P) of the base of the **** rectangular-head drill 21, a pitch P is specified and the concavo-convex field 4 which has the same effect as the above-mentioned example can be formed. Moreover, although the above-mentioned example is an example which gave the concavo-convex side 4 to surface 19a of the transparency covering 19, the same effect as the above-mentioned example is expectable by making the surface into the above-mentioned concavo-convex field 4 also about the transparency covering 19 and the infrared transparency components arranged by the optical path which results in the infrared detecting element 2.

[0021] By thus, the thing for which height H forms the heights 3 of the **** rectangular-head drill 21 of abbreviation lambda/(4n1/2) in surface 1a of the infrared transparency section 1 in the pitch P of 0.2-0.4lambda, and surface 1a of the infrared transparency section 1 is made into the concavo-convex side 4 Since the concavo-convex side 4 turns into an interface from which a refractive index n changes continuously and a refractive-index difference with air changes gradually in this interface, The amount of infrared radiation which a reflective loss can decrease, and the infrared permeability t can be raised, consequently reaches the infrared detecting element 2 can increase, and the sensitivity of an infrared sensor can be raised. Moreover, since the amount of infrared radiation which reaches the infrared detecting element 2 increases, gain of amplifier required for the infrared detecting element 2 can be made small, and a S/N ratio can be raised. Moreover, since the infrared transparency section 2 which consists of the above-mentioned concavo-convex field 4 has the same effect as an antireflection film, it can stop the ghost light by the multiple echo in an interface, and it can be used for it as a slight movement detection sensor of high sensitivity. Moreover, in order to reduce a reflective loss by making into the concavo-convex field 4 surface 19a of the transparency covering 19 which is the infrared transparency section 1, the vacuum membrane formation process to the infrared transparency section 1 etc. becomes it is unnecessary and possible [manufacturing an infrared sensor by low cost]. In addition, since the infrared wavelength emitted from the body by using as the infrared radiation of the range of 5-15 micrometers infrared wavelength lambda which the above-mentioned infrared sensor uses goes into the above-mentioned wavelength range region, it can use as a sensor for body detection of high sensitivity.

[0022] Next, other examples of the gestalt of operation of this invention are shown in drawing 2 . Drawing 2 shows the fragmentary sectional view of the infrared transparency section 1 of an infrared sensor. While this example forms the concavo-convex field 4 (illustration abbreviation) where height H forms the heights 3 of the **** rectangular-head drill 21 of 0.2-0.4lambda in surface 1a, and abbreviation lambda/(4n1/2) and a pitch P are constituted from heights 3 by surface 1a The case where infrared radiation carries out incidence also to rear-face 1b perpendicularly to the infrared transparency section 1 in which the

concavo-convex field 4 (illustration abbreviation) which consists of heights 3 like surface 1a was formed is shown. As a reflective loss at the time of infrared radiation penetrating the infrared transparency section 1 here, in case the light (it considers as the surface reflected light 25) which carries out surface reflection in case incident light 22 carries out incidence to surface 1a of the infrared transparency section 1 and the light 23 which penetrates the infrared transparency section 1, i.e., the transmitted light, penetrate rear-face 1b of the infrared transparency section 1, there is light (it considers as the rear-face reflected light 26) which carries out rear-face reflection. And in the case of this example, a reflective loss will be large, so that the refractive index n to the infrared wavelength which can express both the reflection factors R in 1d of incidence interfaces and outgoing radiation interface 1e with R= (n-1/n+1) 2, and is used is large. Thus, the reflective loss of the amount which multiplied incident light 22 and the transmitted light 23 by the above-mentioned reflection factor R by front reverse side both sides 1a and 1b of the infrared transparency section 1 will arise. Then, while forming the concavo-convex field 4 where height H forms the heights 3 of the **** rectangular-head drill 21 of 0.2-0.4lambda in surface 1a of the infrared transparency section 1 like this example, and abbreviation lambda/(4n1/2) and a pitch P are constituted from heights 3 by surface 1a By forming the concavo-convex field 4 constituted from heights 3 by rear-face 1b of the infrared transparency section 1 as well as surface 1a Since both reflective losses in case a reflective loss and infrared radiation (transmitted light 23) in case infrared radiation (incident light 22) carries out incidence to surface 1a of the infrared transparency section 1 carry out outgoing radiation from rear-face 1b of the infrared transparency section 1 can be reduced The amount of infrared radiation which the infrared permeability t can be raised further, consequently reaches the infrared detecting element 2 can increase further, and the sensitivity of an infrared sensor can be raised more. When polyethylene resin is used for the infrared transparency section 1, in addition, the refractive index n of polyethylene Since it is n= 1.5, the reflection factor R to vertical incidence Become R= 4% and the infrared radiation of 100, then 96 runs the inside of the infrared transparency section 1 in the infrared radiation (incident light 22) which carries out incidence. This infrared radiation of 96 is absorbed in proportion to the thickness of the infrared transparency section 1 within the infrared transparency section 1. The amount which deducted the amount absorbed in the infrared transparency section 1 among the infrared radiation of 96 serves as infrared radiation (transmitted light 23) which reaches rear-face 1b of the infrared transparency section 1, and 96% of this will penetrate rear-face 1b, and will come out outside as an outgoing radiation light 24.

[0023] By the way, actual infrared permeability t' becomes that in which the factor in an operating environment influenced the infrared permeability t of the material to be used. Especially the fall of actual infrared permeability t' by the dirt of surface 19a of the transparency covering 19 (see drawing 1) affects the sensitivity of an infrared sensor remarkably. therefore -- transparency -- covering -- 19 -- the surface -- 19 -- a -- dirt -- attaching -- being hard -- processing -- or -- dirt -- removing -- being easy -- processing -- giving -- if -- transparency -- covering -- 19 -- the surface -- 19 -- a -- dirt -- depending -- being actual -- infrared radiation -- permeability -- t -- ' -- a fall -- as much as possible -- it can stop . As dirt with which surface 19a of the transparency covering 19 is especially easy to be stained, in case it dries after moisture's adhering to surface 19a of the transparency covering 19, it is dirt which remains as residue. For this reason, since it will flow as it is, it will fall and dirt will stop being attached easily even if moisture adheres to surface 1a of the infrared transparency section 1 if water-repellent processing is performed to surface 1a of the infrared transparency section 1, the fall of infrared permeability t' can be prevented.

[0024] Next, other examples of the gestalt of operation of this invention are shown in drawing 3 . This example shows the manufacture method of the infrared transparency section 1 that the concavo-convex side 4 was formed in surface 1a. First, the material 6 with the photosensitivity and infrared permeability used as the infrared transparency section 1 is prepared (drawing 3 (a)). next, the globular form particle 5 of homogeneity particle size which has infrared permeability is further looked like [surface 6a of a material 6], it is covered with it, and the particle layer 7 is formed (drawing 3 (b)). Then, surface 6a of a material 6 is exposed from the outside of the particle layer 7 by making the particle layer 7 into the lens array 8 (drawing 3 (c)). Since each globular form particle 5 which forms the particle layer 7 condenses light like a

lens at this time, the optical intensity distribution of surface 6a of the material 6 at the time of exposure become what was repeated in the same pitch P as the particle size of the globular form particle 5 of homogeneity particle size, consequently the concavo-convex field 4 corresponding to these optical intensity distribution is formed in surface 6a of a material 6. In addition, since the pitch P of the concavo-convex side 4 changes the degree of capital according to the infrared wavelength lambda to be used, it selects the particle size of the globular form particle 5 according to this, and adjusts the pitch P of the concavo-convex field 4 suitably. Thus, according to the manufacture method of the infrared transparency section 1 shown in this example, by selecting the particle size of the globular form particle 5 to be used to arbitration, it can perform easily establishing the concavo-convex field 4 in surface 1a of the infrared transparency section 1 in the pitch P of arbitration, and can carry out by putting in block formation of the concavo-convex field 4.

[0025] Next, other examples of the gestalt of operation of this invention are shown in drawing 4 . This example shows the manufacture method of the infrared transparency section 1 that the concavo-convex side 4 was formed in surface 1a. First, the material 6 with the photosensitivity and infrared permeability used as the infrared transparency section 1 is prepared (drawing 4 (a)). next, while looking like [surface 6a of a material 6] further the globular form particle 5 of homogeneity particle size which has infrared permeability, covering it with it and forming the particle layer 7, the laminating of the transparence base material 27 which has the infrared permeability which applied adhesives on the particle layer 7 at rear-face 27b is carried out (drawing 4 (b)). Then, surface 6a of a material 6 is exposed from the outside of the transparence base material 27 by making into the lens array 8 the particle layer 7 pasted up on rear-face 27b of the transparence base material 27 (drawing 4 (c)). Of this, as well as the example of drawing 3 , the optical intensity distribution of surface 6a of the material 6 at the time of exposure become what was repeated in the same pitch P as the particle size of the globular form particle 5 of homogeneity particle size, consequently the concavo-convex field 4 corresponding to these optical intensity distribution is formed in surface 6a of a material 6. Thus, also by the manufacture method of the infrared transparency section 1 shown in this example, the same effect as the example of drawing 3 is expectable.

[0026] Next, other examples of the gestalt of operation of this invention are shown in drawing 5 . This example shows the manufacture method of the infrared transparency section 1 that the concavo-convex side 4 was formed in surface 1a. First, the material 6 with the photosensitivity and infrared permeability used as the infrared transparency section 1 is prepared (drawing 5 (a)). next, particle size -- mutual -- abbreviation -- it is equal, and globular form particle 5a which has permeability to a certain light, and globular form particle 5b which has absorptivity to said light are mixed, surface 6a of a material 6 is resembled further, it covers, and the particle layer 7 is formed (drawing 5 (b)). Then, surface 6a of a material 6 is exposed through the particle layer 7 with said light (drawing 5 (c)). Globular form particle 5a which has permeability to the light used for exposure among two kinds of globular form particles 5a and 5b which form the particle layer 7 at this time Since light is condensed like a lens, while forming a crevice 28 in surface 6a of a material 6, in order for globular form particle 5b which has absorptivity to the light used for exposure to absorb light and to carry out the role of a mask, surface 6a of a material 6 is not exposed. Consequently, if a crevice 28 will be formed and two kinds of globular form particles 5a and 5b are mixing only the part which allotted globular form particle 5a which has permeability to the light used for exposure to surface 6a of a material 6 to abbreviation homogeneity, a crevice 28 is formed in surface 6a of a material 6 in pitches, such as abbreviation. then -- if the particle layer 7 is removed -- surface 6a of a material 6 -- abbreviation -- the regular concavo-convex side 4 can be acquired (drawing 5 (d)). Thus, according to the manufacture method of the infrared transparency section 1 shown in this example, detailed mask processing can be easily performed to surface 1a of the infrared transparency section 1, and formation of the concavo-convex field 4 can be put in block, and can be performed.

[0027] Next, other examples of the gestalt of operation of this invention are shown in drawing 6 . This example shows the manufacture method of the infrared transparency section 1 that the concavo-convex side 4 was formed in surface 1a. First, the material 6 with the photosensitivity and infrared permeability used as the infrared transparency section 1 is prepared (drawing 6 (a)). next, the abbreviation for particle

size -- two kinds of equal globular form particles 5c and 5d are mixed, surface 6a of a material 6 is resembled further, is covered, and the particle layer 7 is formed (drawing 6 (b)). Then, only 5d of globular form particles is removed among two kinds of globular form particles 5c and 5d (drawing 6 (c)). Then, ablation processing is performed to surface 6a of a material 6 by using globular form particle 5c which remained as a mask (drawing 6 (d)). If a crevice 28 is formed in the location except the part which allotted globular form particle 5c of surface 6a of a material 6 by this and two kinds of globular form particles 5c and 5d are being mixed to abbreviation homogeneity, a crevice 28 is formed in surface 6a of a material 6 in pitches, such as abbreviation. then -- if globular form particle 5c is removed -- surface 6a of a material 6 -- abbreviation -- the regular concavo-convex side 4 can be acquired (drawing 6 (e)). Thus, according to the manufacture method of the infrared transparency section 1 shown in this example, detailed mask processing can be easily performed to surface 1a of the infrared transparency section 1, and it can carry out by putting in block formation of the concavo-convex field 4.

[0028] Next, other examples of the gestalt of operation of this invention are shown in drawing 7 . This example shows the manufacture method of the infrared transparency section 1 that the concavo-convex field 4 was formed in surface 1a, and shows the method by precision cutting by the diamond tool 17. First, the material 16 with infrared permeability used as the infrared transparency section 1 is prepared (drawing 7 (a)). Next, what article thing slots 29 are formed in the lengthwise direction of surface 16a of a material 16 by deciding the processing pitch and the processing depth of precision cutting, cutting a material 16 to a lengthwise direction in said processing depth using the diamond tool 17 ground so that it might become whenever [point-angle / which is decided based on this], and sending a diamond tool 17 to a longitudinal direction one by one in said processing pitch (drawing 7 (b)). Then, a material 16 is cut in a longitudinal direction in said processing depth, and the concavo-convex field 4 formed in the longitudinal direction of surface 16a of a material 16 by constituting continuously the heights 3 of the **** rectangular-head drill 21 especially therefore (drawing 7 (c)) shown in drawing 7 (d) which form what articles thing slots 29 by sending a diamond tool 17 to a lengthwise direction one by one in said processing pitch is acquired. In addition, height H of the heights 3 of the **** rectangular-head drill 21 considers as abbreviation lambda/(4n1/2), and it is made for the pitch P which allots the heights 3 of the **** rectangular-head drill 21 to be set to 0.2-0.4lambda as stated above. Thus, according to the manufacture method of the infrared transparency section 1 shown in this example, since the heights 3 of the **** rectangular-head drill 21 can be continuously formed in surface 1a of the infrared transparency section 1 in the fixed pitch P, the concavo-convex field 4 can be easily formed with high degree of accuracy.

[0029] Next, other examples of the gestalt of operation of this invention are shown in drawing 8 . This example shows the manufacture method of the infrared transparency section 1 that the concavo-convex side 4 was formed in surface 1a. First, the material 16 with infrared permeability used as the infrared transparency section 1 is prepared (drawing 8 (a)). Next, the globular form particle 18 of homogeneity particle size is sprayed on surface 16a of a material 16 in the condition of having heated this material 16 and having made it softening. If the globular form particle 18 is embedded for the softened material 16 at this time, it makes and fixes and surface 16a of a material 16 is covered by the globular form particle 18, since the globular form particle 18 sprayed after it will fall without fixing, much more particle layer 30 which consists of a globular form particle 18 which fixed is formed in surface 16a of a material 16 (drawing 8 (b)). Then, if much more particle layer 30 which consists of this globular form particle 18 is removed, the peripheral face of the globular form particle 18 is imprinted, and a crevice 28 will continue all over surface 16a of a material 16, it will be formed, and the concavo-convex field 4 will be formed in surface 16a of a material 16 of this (drawing 8 (c)). In addition, according to the infrared wavelength lambda used also in this example, the particle size of the globular form particle 18 can be selected, and the pitch P of the concavo-convex field 4 formed can be adjusted suitably. Moreover, the portion which does not need the concavo-convex side 4 by surface 16a of a material 16 can form the necessary concavo-convex side 4 by carrying out a mask beforehand. Thus, according to the manufacture method of the infrared transparency section 1 shown in this example, it can perform easily establishing the concavo-convex field 4 in surface 1a of the infrared transparency section 1 in the pitch P of arbitration, and can carry out by putting in block

formation of the concavo-convex field 4.
[0030] Next, other examples of the gestalt of operation of this invention are shown in drawing 9 . This example shows the manufacture method of the infrared transparency section 1 that the concavo-convex side 4 was formed in surface 1a. First, the material 16 with infrared permeability used as the infrared transparency section 1 is prepared (drawing 9 (a)). Next, the globular form particle 18 of homogeneity particle size is sprayed on surface 16a of a material 16 at the same time it heats and softens surface 16a of a material 16, scanning surface 16a of this material 16 by laser 41 (drawing 9 (b)). If the globular form particle 18 is embedded for the softened material 16 at this time, it makes and fixes and surface 16a of a material 16 is covered by the globular form particle 18, since the globular form particle 18 sprayed after it will fall without fixing, much more particle layer 30 which consists of a globular form particle 18 which fixed is formed in surface 16a of a material 16 (drawing 9 (c)). Then, if much more particle layer 30 which consists of this globular form particle 18 is removed, the crevice 28 made by imprinting the peripheral face of the globular form particle 18 will be formed in surface 16a of a material 16, and the concavo-convex field 4 will be formed in surface 16a of a material 16 of this (drawing 9 (d)). In addition, according to the infrared wavelength lambda used also in this example, the particle size of the globular form particle 18 can be selected, and the pitch P of the concavo-convex field 4 formed can be adjusted suitably. Thus, according to the manufacture method of the infrared transparency section 1 shown in this example, it can perform easily establishing the concavo-convex field 4 in surface 1a of the infrared transparency section 1 in the pitch P of arbitration, and can carry out by putting in block formation of the concavo-convex field 4. And since only a required portion scans surface 16a of a material 16 by laser 41 and the concavo-convex field 4 should just spray the globular form particle 18, the concavo-convex side 4 can be formed free.
[0031] In addition, it is clear that the concavo-convex field 4 can be formed also in rear-face 1b of the infrared transparency section 1 by the manufacture method stated in the example of above-mentioned drawing 3 thru/or drawing 9 .
[0032] By the way, all the manufacture methods of the infrared transparency section 1 shown in above-mentioned drawing 3 thru/or the example of drawing 9 are the methods by the fabrication which used metal mold, and since they need processing of a detailed configuration for surface 1a of the infrared transparency section 1 of this invention when it is going to apply the method by the fabrication which used metal mold for manufacture of the infrared transparency section 1 of this invention, by the method by the fabrication using the usual metal mold, implementation is difficult for them. Then, the manufacture method of the infrared transparency section 1 shown in drawing 10 The infrared transparency section 1 obtained by either of the manufacture methods of the infrared transparency section 1 shown in the example of drawing 3 thru/or drawing 9 is considered as a master 31 (drawing 10 (a)). The material 16 which performs electrocasting to this, produces the electrocasting imprint metal mold 32 (drawing 10 (b)), and has infrared permeability by using this electrocasting imprint metal mold 32 as metal mold 9 by carrying out fabrication (Drawing 10 (c)), The infrared transparency section 1 by which the concavo-convex side 4 was formed in surface 1a is manufactured (drawing 10 (d)). Thus, if it is electrocasting, since the concavo-convex field 4 of surface 31a of a master 31 can also be imprinted enough, precise mold processing can be realized and processing of the concavo-convex field 4 of surface 1a of the infrared transparency section 1 of this invention also becomes possible.
[0033] Next, other examples of the gestalt of operation of this invention are shown in drawing 11 . It is the way this example produces a mold 35 by the globular form particle 11 of SiO2 to having been the way this example shows the manufacture method of the infrared transparency section 1 that the concavo-convex side 4 was formed in surface 1a, and said example produced metal mold 9 in electrocasting. First, the master mold 12 of a three-dimension configuration is produced as a mold, and the liquid 33 which made the solution 10 which added the binder in this master mold 12 distribute the globular form particle 11 of SiO2 is slushed (drawing 11 (a)). In addition, for example, an alkoxysilane compound, a fluoro alkyl xylan compound, etc. are used for a binder. Next, since the globular form particle 11 of SiO2 accumulates on the pars basilaris ossis occipitalis of a master mold 12 with the passage of time (drawing 11 (b)), after the globular form particle 11 of SiO2 has fully accumulated on the pars basilaris ossis occipitalis of a master mold 12

By drying this, making the amount of [except the binder in the solution 10 which added the binder] liquid evaporate, and heating the sediment 13 which remained further The binder in a sediment 13 is made to hydrolyze and it is made only for the thing 39 which the globular form particle 11 of SiO2 which carried out siloxane association solidified to remain in the pars basilaris ossis occipitalis of a master mold 12 (drawing 11 (c)). If a master mold 12 is furthermore removed, the mold 35 which was able to solidify and do the globular form particle 11 of SiO2 will be done (drawing 11 (d)). (Drawing 11 (e)) and the infrared transparency section 1 by which the concavo-convex side 4 was formed in surface 1a can be manufactured by carrying out fabrication of the material 16 which has infrared permeability using this mold 35 (drawing 11 (f)). In addition, the example which processes the mold 35 of a more complicated three-dimension configuration is shown in drawing 12 . This example produces the master mold 12 of the three-dimension configuration used as the mold of a mold 35 so that the mold 35 which carried out the complicated three-dimension configuration may be obtained, and each production process of drawing 12 (a) - drawing 12 (f) is the same as the example of drawing 11 . Since processing of the mold of a complicated configuration with a detailed concavo-convex field can also be easily performed according to the manufacture method of the infrared transparency section 1 shown in this example as shown also in this example, various formation of the infrared transparency section is enabled.
[0034] Next, other examples of the gestalt of operation of this invention are shown in drawing 13 . This example shows the manufacture method of the infrared transparency section 1 that the concavo-convex side 4 was formed in surface 1a. First, while producing a mold 35 by the manufacture method shown in the example of drawing 11 and drawing 12 , the material 16 which has infrared permeability is prepared (drawing 13 (a)). Next, it is carrying out hot press of the mold 35 to surface 16a of a material 16 (drawing 13 (b)), the shape of toothing of the forcing side 36 of a mold 35 is imprinted by surface 16a of a material 16, and the infrared transparency section 1 by which the concavo-convex side 4 was formed in surface 1a can be manufactured (drawing 13 (c)). In addition, when the infrared transparency section 1 which forms the concavo-convex side 4 in surface 1a consists of planes In the manufacture method shown in the example of drawing 11 and drawing 12 even when it was able to manufacture easily and the infrared transparency section 1 consisted of curved surfaces, in order that the forcing side 36 might just use the plane mold 35 The infrared transparency section 1 which forms the concavo-convex field 4 in surface 1a like an above-mentioned method by producing the master mold 12 which has a curved surface, and producing the mold 35 with which it pushes using this and a field 36 becomes curved surface-like is obtained. Thus, since according to the manufacture method of the infrared transparency section 1 shown in this example the time amount which an imprint takes compared with the fabrication by metal mold 9 is short and ends, a manufacture cycle can be shortened and productivity can be raised.
[0035] Next, the manufacture method of the infrared transparency section 1 which are other examples of the gestalt of operation of this invention that the concavo-convex side 4 was formed in surface 1a is explained. First, crystal orientation prepares a silicon wafer as a material 14 in a field (111) 37. Next, this silicon wafer can be etched with solutions, such as KOH and NaOH, and (drawing 14's showing the crystal lattice 34 of silicon) and the concavo-convex field (not shown) formed in the surface of a silicon wafer by constituting the regular triangular pyramid 38 continuously can be acquired by making the field (111) 37 of the crystal lattice 34 of silicon express. In addition, the method of producing a pattern mask by resist exposure and the manufacture method shown in the example of drawing 5 and drawing 6 may be used to control the pitch of this concavo-convex side. Then, the infrared transparency section 1 by which the concavo-convex side 4 was formed in surface 1a can be manufactured by carrying out fabrication of the material 16 which considers this silicon wafer as a master 31 (see drawing 10 hereafter), performs electrocasting to this, produces the electrocasting imprint metal mold 32, and has infrared permeability by using this electrocasting imprint metal mold 32 as metal mold 9. Thus, according to the manufacture method of the infrared transparency section 1 shown in this example, the regular concavo-convex field 4 can be formed easily.
[0036] Next, other examples of the gestalt of operation of this invention are shown in drawing 15 . This example shows the manufacture method of the infrared transparency section 1 that the concavo-convex

side 4 was formed in surface 1a. First, the film 15 which has infrared permeability is prepared and the concavo-convex side 4 is formed in surface 15a of a film 15 by carrying out fabrication of this with the metal mold 9 produced by either of the manufacture methods shown in the example of drawing 10 or drawing 14 (drawing 15 (a)). And it sticks on surface 16a of a material 16 which has infrared permeability so that surface 15a of this film 15 may become a table (drawing 15 (b)). Thereby, the infrared transparency section 1 by which the concavo-convex side 4 was formed in surface 1a can be manufactured. In addition, although the metal mold 9 produced by either of the manufacture methods shown in the example of drawing 10 or drawing 14 was used in this example, it is also possible to use the mold 35 produced by the manufacture method shown in the example of drawing 11 and drawing 12 . Thus, according to the manufacture method of the infrared transparency section 1 shown in this example, since the above-mentioned film 15 can be stuck also on the infrared transparency section 1 of various configurations, according to the configuration of the infrared transparency section 1, the concavo-convex side 4 can be formed free, and the infrared permeability t can be raised.

[0037]

[Effect of the Invention] If it is in invention of this invention according to claim 1 and the refractive index to the infrared wavelength which the infrared transparency section uses is set to n in the infrared sensor equipped with the infrared transparency section and an infrared detecting element By preparing the heights which are abbreviation 1 / (4n1/2) twice the infrared wavelength which height uses in the external surface of the infrared transparency section on the wavelength 0.2 to 0.4 times the pitch of infrared to be used, and making the external surface of the infrared transparency section into a concavo-convex side The amount of infrared radiation which a concavo-convex field turns into an interface from which a refractive index changes continuously, a reflective loss can decrease and infrared permeability can be raised since a refractive-index difference with air changes gradually in this interface, consequently reaches an infrared detecting element can increase, and the sensitivity of an infrared sensor can be raised. Moreover, since the amount of infrared radiation which reaches an infrared detecting element increases, gain of amplifier required for an infrared detecting element can be made small, and a S/N ratio can be raised. Moreover, since the infrared transparency section which consists of the above-mentioned concavo-convex field has the same effect as an antireflection film, it can stop the ghost light by the multiple echo in an interface, and it can be used for it as a slight movement detection sensor of high sensitivity. Moreover, in order to reduce a reflective loss by making into a concavo-convex field the external surface of transparency covering which is the infrared transparency section, the vacuum membrane formation process to the infrared transparency section etc. becomes it is unnecessary and possible [manufacturing an infrared sensor by low cost].

[0038] Moreover, if it is in invention of this invention according to claim 2 To an effect of the invention according to claim 1, by in addition, the thing for which heights are prepared in the rear face of the infrared transparency section as well as the surface, and front reverse side both sides of the infrared transparency section are made into a concavo-convex field Since both reflective losses in case a reflective loss and infrared radiation in case infrared radiation carries out incidence to the surface of the infrared transparency section carry out outgoing radiation from the rear face of the infrared transparency section can be reduced The amount of infrared radiation which infrared permeability can be raised further, consequently reaches an infrared detecting element can increase further, and the sensitivity of an infrared sensor can be raised more.

[0039] Moreover, if it is in invention of this invention according to claim 3, in addition to an effect of the invention according to claim 1 or 2, by performing water-repellent processing to the external surface of the infrared transparency section, even if moisture adheres to the surface of the infrared transparency section, it flows as it is and falls, and since it is made hard to attach dirt, decline in infrared permeability can be prevented.

[0040] Moreover, if it is in invention of this invention according to claim 4, since the infrared wavelength emitted from the body by using infrared wavelength to be used as the infrared radiation of the range of 5-15 micrometers in addition to an effect of the invention according to claim 1 to 3 goes into the above-

mentioned wavelength range region, it can use as a sensor for body detection of high sensitivity.

[0041] Moreover, if it is in invention of this invention according to claim 5 Look like [the external surface of the material which has photosensitivity and infrared permeability] further the globular form particle of homogeneity particle size which has infrared permeability, cover it with it, form a particle layer, and this particle layer is made into a lens array. By forming a concavo-convex field in the external surface of the infrared transparency section arranged in the optical path which results in an infrared detecting element by removing this particle layer, after exposing the external surface of a material from the outside of a particle layer By selecting the particle size of the globular form particle to be used to arbitration, it can perform easily establishing a concavo-convex side in the external surface of the infrared transparency section in the pitch of arbitration, and can carry out by putting formation of a concavo-convex side in block.

[0042] Moreover, if it is in invention of this invention according to claim 6 Resemble further the external surface of the material which mixes two kinds of equal globular form particles, and has photosensitivity and infrared permeability, cover it, and a particle layer is formed. the abbreviation for particle size whose another side one side has permeability to a certain light, and has absorptivity -- By forming a concavo-convex field in the external surface of the infrared transparency section arranged in the optical path which results in an infrared detecting element by removing a particle layer, after exposing the external surface of a material through this particle layer with said light Detailed mask processing can be easily carried out to the external surface of the infrared transparency section, and formation of a concavo-convex field can be put in block, and can be performed.

[0043] Moreover, if it is in invention of this invention according to claim 7 the abbreviation for particle size, after resembling further the external surface of the material which mixes two kinds of equal globular form particles, and has photosensitivity and infrared permeability, covering it and forming a particle layer By removing the globular form particle which remained, after removing only the globular form particle of either of two kinds of globular form particles and performing ablation processing to the external surface of a material by using the globular form particle which remained as a mask By forming a concavo-convex field in the external surface of the infrared transparency section arranged in the optical path which results in an infrared detecting element, detailed mask processing can be easily carried out to the external surface of the infrared transparency section, and it can carry out by putting formation of a concavo-convex field in block.

[0044] Moreover, if it is in invention of this invention according to claim 8, since the heights of a **** rectangular-head drill can be continuously formed in the external surface of the infrared transparency section in a fixed pitch by forming a concavo-convex field in the external surface of the material which has infrared permeability by precision cutting by the diamond tool, a concavo-convex field can be easily formed with high degree of accuracy.

[0045] Moreover, if it is in invention of this invention according to claim 9 After making the external surface of a material spray and fix the globular form particle of homogeneity particle size in the condition of having heated the external surface of the material which has infrared permeability, and having made it softening, by removing this globular form particle By forming a concavo-convex field in the external surface of the infrared transparency section arranged in the optical path which results in an infrared detecting element, it can perform easily establishing a concavo-convex side in the external surface of the infrared transparency section in the pitch of arbitration, and can carry out by putting formation of a concavo-convex field in block.

[0046] Moreover, if it is in invention of this invention according to claim 10 By producing the metal mold which imprinted the concavo-convex field by considering as a master the infrared transparency section manufactured in the manufacture method of an infrared sensor according to claim 5 to 9, and carrying out fabrication using this metal mold By forming a concavo-convex side in the external surface of the infrared transparency section arranged in the optical path which results in an infrared detecting element Even when it is difficult to manufacture direct metal mold, by considering the infrared transparency section already manufactured by other manufacture methods as a master, metal mold can be processed easily and die forming of the detailed concavo-convex field of the infrared transparency section becomes possible.

[0047] Moreover, if it is in invention of this invention according to claim 11 Produce the master mold of a three-dimension configuration, fill the thing which made the solution which added the binder distribute the globular form particle of SiO_2 in a master mold, and the globular form particle of SiO_2 is made to deposit. By heating the sediment which was made to dry this and remained, producing a mold by removing a master mold, after removing a binder and making it solidify, and carrying out fabrication of the material which has infrared permeability using this mold Since processing of the mold of a complicated configuration with a detailed concavo-convex side can also be easily performed by forming a concavo-convex side in the external surface of the infrared transparency section arranged in the optical path which results in an infrared detecting element, various formation of the infrared transparency section is enabled.
[0048] Moreover, if it is in invention of this invention according to claim 12 By forming a concavo-convex side in the external surface of the infrared transparency section arranged in the optical path which results in an infrared detecting element by carrying out hot press of the mold produced in the manufacture method of an infrared sensor according to claim 11 to the external surface of the material which has infrared permeability Since the time amount which an imprint takes compared with the fabrication by metal mold is short and ends, a manufacture cycle can be shortened and productivity can be raised.
[0049] Moreover, if it is in invention of this invention according to claim 13 By having infrared permeability and crystal orientation etching the material of a field (111) By forming a concavo-convex side in the external surface of the infrared transparency section arranged in the optical path which results in an infrared detecting element by forming a concavo-convex field in the external surface of a material, producing the metal mold which imprinted the concavo-convex field by considering this material as a master, and carrying out fabrication using this metal mold A regular concavo-convex side can be formed easily.
[0050] Moreover, if it is in invention of this invention according to claim 14 By carrying out fabrication of the film which has infrared permeability with the metal mold or the mold produced in the manufacture method of the infrared sensor a publication by either of claims 10, 11, and 13, and sticking on the external surface of the material which has infrared permeability By forming a concavo-convex side in the external surface of the infrared transparency section arranged in the optical path which results in an infrared detecting element Since the above-mentioned film can be stuck also on the infrared transparency section of various configurations, according to the configuration of the infrared transparency section, a concavo-convex side can be formed free, and infrared permeability can be raised.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The perspective diagram of a concavo-convex field which showed an example of the gestalt of operation of this invention, gave (a) to the perspective diagram of the principal part of an infrared sensor, and gave (b) to the surface of the infrared transparency section of an infrared sensor, and (c) are the cross sections of heights established in the surface of the infrared transparency section of an infrared sensor.
[Drawing 2] Other examples of the gestalt of operation of this invention are shown, and it is the fragmentary sectional view of the infrared transparency section of an infrared sensor.
[Drawing 3] Other examples of the gestalt of operation of this invention are shown, and (a) - (c) is manufacturing process drawing of the infrared transparency section of an infrared sensor.
[Drawing 4] Other examples of the gestalt of operation of this invention are shown, and (a) - (c) is manufacturing process drawing of the infrared transparency section of an infrared sensor.
[Drawing 5] Other examples of the gestalt of operation of this invention are shown, and (a) - (d) is manufacturing process drawing of the infrared transparency section of an infrared sensor.
[Drawing 6] Other examples of the gestalt of operation of this invention are shown, and (a) - (e) is manufacturing process drawing of the infrared transparency section of an infrared sensor.
[Drawing 7] It is the perspective diagram of a concavo-convex field which showed other examples of the gestalt of operation of this invention, gave (a) - (c) to manufacturing process drawing of the infrared transparency section of an infrared sensor, and gave (d) to the surface of the infrared transparency section.
[Drawing 8] Other examples of the gestalt of operation of this invention are shown, and (a) - (c) is manufacturing process drawing of the infrared transparency section of an infrared sensor.
[Drawing 9] Other examples of the gestalt of operation of this invention are shown, and (a) - (d) is manufacturing process drawing of the infrared transparency section of an infrared sensor.
[Drawing 10] Other examples of the gestalt of operation of this invention are shown, and (a) - (d) is manufacturing process drawing of the infrared transparency section of an infrared sensor.
[Drawing 11] Other examples of the gestalt of operation of this invention are shown, and (a) - (f) is manufacturing process drawing of the infrared transparency section of an infrared sensor.
[Drawing 12] Other examples of the gestalt of operation of this invention are shown, and (a) - (f) is manufacturing process drawing of the infrared transparency section of an infrared sensor.
[Drawing 13] Other examples of the gestalt of operation of this invention are shown, and (a) - (c) is manufacturing process drawing of the infrared transparency section of an infrared sensor.
[Drawing 14] It is drawing showing the crystal lattice of silicon.
[Drawing 15] Other examples of the gestalt of operation of this invention are shown, and (a) - (b) is manufacturing process drawing of the infrared transparency section of an infrared sensor.
[Description of Notations]
1 Infrared Transparency Section
1a Surface
1b Rear face
1c External surface
2 Infrared Detecting Element

3 Heights
4 Concavo-convex Side
5 Globular Form Particle
5a Globular form particle
5b Globular form particle
5c Globular form particle
5d Globular form particle
6 Material
6c External surface
7 Particle Layer
8 Lens Array
9 Metal Mold
10 Solution Which Added Binder
11 Globular Form Particle of SiO2
12 Master Mold
13 Sediment
14 Material
15 Film
16 Material
16c External surface
18 Globular Form Particle
21 **** Rectangular-Head Drill
35 Mold
37 111 Field
lambda Infrared wavelength
n The refractive index to the infrared wavelength to be used
H Height
P Pitch

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（Ａ）　(11)特許出願公開番号
特開2001－4442
（P2001－4442A）
(43)公開日　平成13年1月12日(2001.1.12)

(51)Int.Cl.⁷	識別記号	ＦＩ		テーマコード゛(参考)
Ｇ０１Ｊ　1/04		Ｇ０１Ｊ	1/04	Ｂ　２Ｇ０６５
Ｂ８１Ｂ　1/00		Ｂ８１Ｂ	1/00	２Ｈ０４２
Ｂ８１Ｃ　1/00		Ｂ８１Ｃ	1/00	２Ｋ００９
Ｇ０２Ｂ　1/11		Ｇ０２Ｂ	3/00	Ａ
3/00				Ｚ

審査請求　未請求　請求項の数14　ＯＬ　（全 14 頁）
最終頁に続く

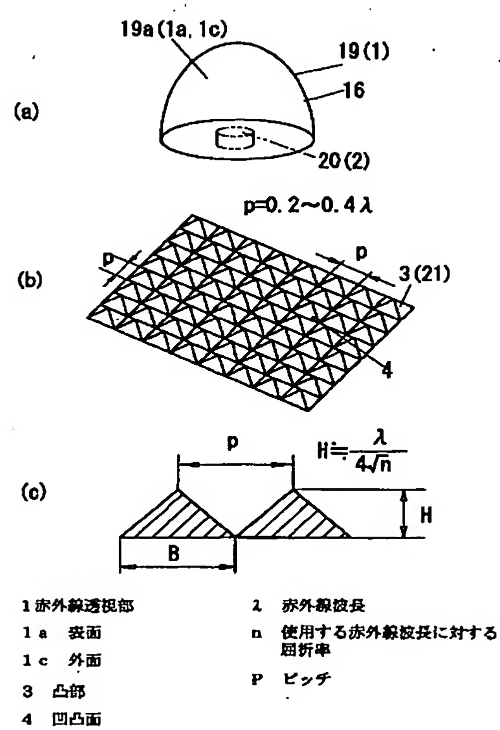
(21)出願番号　特願平11－180250
(22)出願日　平成11年6月25日(1999.6.25)

(71)出願人　000005832
松下電工株式会社
大阪府門真市大字門真1048番地
(72)発明者　福島　博司
大阪府門真市大字門真1048番地松下電工株式会社内
(72)発明者　中田　公明
大阪府門真市大字門真1048番地松下電工株式会社内
(74)代理人　100087767
弁理士　西川　惠清　（外1名）

最終頁に続く

(54)【発明の名称】　赤外線センサー及びその製造方法

(57)【要約】
【課題】　従来品と比べて、赤外線透過率の高い赤外線透過部を備え、感度を向上させることができ、且つ低コストで製造できる赤外線センサー及びその製造方法を提供する。
【解決手段】　赤外線透過部１と赤外線検出部２を備えた赤外線センサーにおいて、赤外線透過部１の使用する赤外線波長λに対する屈折率をｎとすると、赤外線透過部１の外面１ｃに高さＨが使用する赤外線波長λの略１／（４ｎ$^{1/2}$）倍の凸部３を、使用する赤外線波長λの０．２～０．４倍のピッチＰで設けて、赤外線透過部１の外面１ｃを凹凸面４にする。



【特許請求の範囲】

【請求項１】　赤外線透過部と赤外線検出部を備えた赤外線センサーにおいて、赤外線透過部の使用する赤外線波長に対する屈折率をｎとすると、赤外線透過部の外面に高さが使用する赤外線波長の略１／（４$n^{1/2}$）倍の凸部を、使用する赤外線波長の０．２～０．４倍のピッチで設けて、赤外線透過部の外面を凹凸面にしたことを特徴とする赤外線センサー。

【請求項２】　赤外線透過部の裏面にも表面と同じように凸部を設け、赤外線透過部の表裏両面を凹凸面にしたことを特徴とする請求項１記載の赤外線センサー。

【請求項３】　赤外線透過部の外面に撥水性処理を施したことを特徴とする請求項１又は２に記載の赤外線センサー。

【請求項４】　使用する赤外線波長が５～１５μｍの範囲の赤外線であることを特徴とする請求項１乃至３のいずれかに記載の赤外線センサー。

【請求項５】　赤外線透過性を有する均一粒径の球形微粒子を感光性及び赤外線透過性を有する素材の外面に一層に敷き詰めて微粒子層を形成し、該微粒子層をレンズアレイとして、微粒子層の外側より素材の外面を露光した後、該微粒子層を除去することで、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成したことを特徴とする赤外線センサーの製造方法。

【請求項６】　ある光に対して一方が透過性を有し、他方が吸収性を有する粒径の略等しい２種類の球形微粒子を混合して感光性及び赤外線透過性を有する素材の外面に一層に敷き詰めて微粒子層を形成し、前記光で該微粒子層を通じて素材の外面を露光した後、微粒子層を除去することで、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成したことを特徴とする赤外線センサーの製造方法。

【請求項７】　粒径の略等しい２種類の球形微粒子を混合して感光性及び赤外線透過性を有する素材の外面に一層に敷き詰めて微粒子層を形成した後、２種類の球形微粒子のうちのいずれか一方の球形微粒子のみを除去し、残った球形微粒子をマスクとして素材の外面にアブレーション加工を施した後、残った球形微粒子を除去することで、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成したことを特徴とする赤外線センサーの製造方法。

【請求項８】　ダイヤモンドバイトによる精密切削で赤外線透過性を有する素材の外面に凹凸面を形成したことを特徴とする赤外線センサーの製造方法。

【請求項９】　赤外線透過性を有する素材の外面を加熱して軟化させた状態で均一粒径の球形微粒子を素材の外面に吹き付けて固着させた後、該球形微粒子を除去することで、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成したことを特徴とする赤外線センサーの製造方法。

【請求項１０】　請求項５乃至９のいずれかに記載の赤外線センサーの製造方法において製造された赤外線透過部をマスターとして凹凸面を転写した金型を作製し、該金型を用いて成形加工することで、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成したことを特徴とする赤外線センサーの製造方法。

【請求項１１】　３次元形状の元型を作製し、バインダを添加した溶液にＳｉＯ２の球形微粒子を分散させたものを元型内に満たしてＳｉＯ２の球形微粒子を堆積させ、これを乾燥させて残った堆積物を加熱してバインダを除去して固化させた後、元型を除去することにより型を作製し、該型を用いて赤外線透過性を有する素材を成形加工することで、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成したことを特徴とする赤外線センサーの製造方法。

【請求項１２】　請求項１１に記載の赤外線センサーの製造方法において作製された型を赤外線透過性を有する素材の外面に加熱プレスすることで、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成したことを特徴とする赤外線センサーの製造方法。

【請求項１３】　赤外線透過性を有し、結晶方位が（１１１）面の素材をエッチングすることで、素材の外面に凹凸面を形成し、該素材をマスターとして凹凸面を転写した金型を作製し、該金型を用いて成形加工することで、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成したことを特徴とする赤外線センサーの製造方法。

【請求項１４】　請求項１０，１１，１３のいずれかに記載の赤外線センサーの製造方法において作製された金型或いは型にて赤外線透過性を有するフィルムを成形加工し、赤外線透過性を有する素材の外面に貼り付けることで、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成したことを特徴とする赤外線センサーの製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、赤外線センサー及び赤外線センサーの製造方法に関し、特に赤外線センサーの赤外線透過部となる透過カバーや赤外線検出素子の透過窓等の部品及びその製造方法に関するものである。

【０００２】

【従来の技術】赤外線センサーは、例えば人体から放射される赤外線を非接触で検知することのできるセンサーで、一般に赤外線検出素子とこれを覆う透過カバーから構成されている。近年、赤外線検出素子の小型化に伴い、センサー全体のサイズが小さくなり、赤外線透過部である透過カバー及び赤外線検出素子の透過窓も小型化されている。このため、赤外線検出素子には微弱な赤外線を検出する感度が要求され、また、一方の赤外線透過部である透過カバー及び赤外線検出素子の透過窓には効

率よく赤外線を透過することが要求される。これらの条件を満たし、さらにはマイクロレンズで赤外線を効率よく赤外線検出素子の赤外線受光部に集束させる赤外線検出素子及びその製造方法が、特開平９－１１３３５２号公報に開示されている。しかしながら、これは、赤外線透過部であるマイクロレンズの製造において、エッチングやフォトリソグラフィなどを用いた複雑な製造工程を必要とするため、非常にコストのかかるものであった。

【０００３】これに対し、赤外線透過部をより低コストに抑える方法として、透過カバーを樹脂にて成形する方法が挙げられる。しかし、樹脂の場合、赤外線透過率ｔが高いポリエチレンであっても、例えば、波長１０μｍの赤外線に対して、厚さ１ｍｍで約５５％、厚さ２ｍｍで約３４％、厚さ３ｍｍで約２０％と、非常に赤外線透過率ｔが低い。このため、透過カバーの肉厚を極力薄くすることが、赤外線透過率ｔを高くする上で必要になる。しかし、透過カバーにはある程度の強度も要求されるため、透過カバーの肉厚が赤外線センサーの設計上のネックになっていた。そして、この透過カバーの肉厚を薄くする手段として、透過カバーのレンズ部をフレネルレンズで構成する方法も考えられるが、微小なフレネルレンズの場合、その形状によっては逆に集光効率が落ちてしまう場合もある。

【０００４】

【発明が解決しようとする課題】本発明は上記の点に鑑みて為されたものであり、従来品と比べて、赤外線透過率の高い赤外線透過部を備え、感度を向上させることができ、且つ低コストで製造できる赤外線センサー及びその製造方法を提供することを目的としている。

【０００５】

【課題を解決するための手段】本発明の請求項１に係る赤外線センサーは、赤外線透過部１と赤外線検出部２を備えた赤外線センサーにおいて、赤外線透過部１の使用する赤外線波長λに対する屈折率をｎとすると、赤外線透過部１の外面１ｃに高さHが使用する赤外線波長λの略１／（４$n^{1/2}$）倍の凸部３を、使用する赤外線波長λの０．２～０．４倍のピッチＰで設けて、赤外線透過部１の外面１ｃを凹凸面４にしたことを特徴とするものである。

【０００６】また、本発明の請求項２に係る赤外線センサーは、請求項１の構成に加えて、赤外線透過部１の裏面１ｂにも表面１ａと同じように凸部３を設け、赤外線透過部１の表裏両面１ａ，１ｂを凹凸面４にしたことを特徴とするものである。

【０００７】また、本発明の請求項３に係る赤外線センサーは、請求項１又は２の構成に加えて、赤外線透過部１の外面１ｃに撥水性処理を施したことを特徴とするものである。

【０００８】また、本発明の請求項４に係る赤外線センサーは、請求項１乃至３のいずれかの構成に加えて、使用する赤外線波長λが５～１５μｍの範囲の赤外線であることを特徴とするものである。

【０００９】また、本発明の請求項５に係る赤外線センサーの製造方法は、赤外線透過性を有する均一粒径の球形微粒子５を感光性及び赤外線透過性を有する素材６の外面６ｃに一層に敷き詰めて微粒子層７を形成し、該微粒子層７をレンズアレイ８として、微粒子層７の外側より素材６の外面６ｃを露光した後、該微粒子層７を除去することで、赤外線検出部２に至る光路に配設する赤外線透過部１の外面１ｃに凹凸面４を形成したことを特徴とするものである。

【００１０】また、本発明の請求項６に係る赤外線センサーの製造方法は、ある光に対して一方が透過性を有し、他方が吸収性を有する粒径の略等しい２種類の球形微粒子５ａ，５ｂを混合して感光性及び赤外線透過性を有する素材６の外面６ｃに一層に敷き詰めて微粒子層７を形成し、前記光で該微粒子層７を通じて素材６の外面６ｃを露光した後、微粒子層７を除去することで、赤外線検出部２に至る光路に配設する赤外線透過部１の外面１ｃに凹凸面４を形成したことを特徴とするものである。

【００１１】また、本発明の請求項７に係る赤外線センサーの製造方法は、粒径の略等しい２種類の球形微粒子５ｃ，５ｄを混合して感光性及び赤外線透過性を有する素材６の外面６ｃに一層に敷き詰めて微粒子層７を形成した後、２種類の球形微粒子５ｃ，５ｄのうちのいずれか一方の球形微粒子５ｃ（５ｄ）のみを除去し、残った球形微粒子５ｄ（５ｃ）をマスクとして素材６の外面６ｃにアブレーション加工を施した後、残った球形微粒子５ｄ（５ｃ）を除去することで、赤外線検出部２に至る光路に配設する赤外線透過部１の外面１ｃに凹凸面４を形成したことを特徴とするものである。

【００１２】また、本発明の請求項８に係る赤外線センサーの製造方法は、ダイヤモンドバイト１７による精密切削で赤外線透過性を有する素材１６の外面１６ｃに凹凸面４を形成したことを特徴とするものである。

【００１３】また、本発明の請求項９に係る赤外線センサーの製造方法は、赤外線透過性を有する素材１６の外面１６ｃを加熱して軟化させた状態で均一粒径の球形微粒子１８を素材１６の外面１６ｃに吹き付けて固着させた後、該球形微粒子１８を除去することで、赤外線検出部２に至る光路に配設する赤外線透過部１の外面１ｃに凹凸面４を形成したことを特徴とするものである。

【００１４】また、本発明の請求項１０に係る赤外線センサーの製造方法は、請求項５乃至９のいずれかに記載の赤外線センサーの製造方法において製造された赤外線透過部１をマスターとして凹凸面４を転写した金型９を作製し、該金型９を用いて成形加工することで、赤外線検出部２に至る光路に配設する赤外線透過部１の外面１ｃに凹凸面４を形成したことを特徴とするものである。

【００１５】また、本発明の請求項１１に係る赤外線センサーの製造方法は、３次元形状の元型１２を作製し、バインダを添加した溶液１０にＳｉＯ２の球形微粒子１１を分散させたものを元型１２内に満たしてＳｉＯ２の球形微粒子１１を堆積させ、これを乾燥させて残った堆積物１３を加熱してバインダを除去して固化させた後、元型１２を除去することにより型３５を作製し、該型３５を用いて赤外線透過性を有する素材１６を成形加工することで、赤外線検出部２に至る光路に配設する赤外線透過部１の外面１ｃに凹凸面４を形成したことを特徴とするものである。

【００１６】また、本発明の請求項１２に係る赤外線センサーの製造方法は、請求項１１に記載の赤外線センサーの製造方法において作製された型３５を赤外線透過性を有する素材１６の外面１６ｃに加熱プレスすることで、赤外線検出部２に至る光路に配設する赤外線透過部１の外面１ｃに凹凸面４を形成したことを特徴とするものである。

【００１７】また、本発明の請求項１３に係る赤外線センサーの製造方法は、赤外線透過性を有し、結晶方位が（１１１）面３７の素材１４をエッチングすることで、素材１４の外面１４ｃに凹凸面４を形成し、該素材１４をマスターとして凹凸面４を転写した金型９を作製し、該金型９を用いて成形加工することで、赤外線検出部２に至る光路に配設する赤外線透過部１の外面１ｃに凹凸面４に形成したことを特徴とするものである。

【００１８】また、本発明の請求項１４に係る赤外線センサーの製造方法は、請求項１０，１１，１３のいずれかに記載の赤外線センサーの製造方法において作製された金型９或いは型３５にて赤外線透過性を有するフィルム１５を成形加工し、赤外線透過性を有する素材１６の外面１６ｃに貼り付けることで、赤外線検出部２に至る光路に配設する赤外線透過部１の外面１ｃに凹凸面４を形成したことを特徴とするものである。

【００１９】

【発明の実施の形態】本発明の実施の形態を図１乃至図１３に基づいて説明する。

【００２０】本発明の実施の形態の一例を図１に示す。この赤外線センサーは図１（ａ）に示すように赤外線透過部１である透過カバー１９と赤外線検出部２である赤外線検出素子２０とから主に構成される。尚、透過カバー１９はポリエチレン等の赤外線透過率ｔの高い樹脂で形成する。既述の通り、赤外線センサーには、その小型化に伴って、微弱な赤外線を検出する感度が要求され、赤外線透過部１について言えば、赤外線透過率ｔの向上が求められている。そこで、本発明の赤外線センサーの透過カバー１９の表面１９ａには図１（ｂ）に示すような凹凸面４を施し、赤外線透過率ｔの向上を図っている。これは、透過カバー１９に赤外線が入射する際の反射ロス、即ち、透過カバー１９内に入射せずに透過カバー１９の表面１９ａで反射される赤外線の割合を低減しようというものである。この反射ロスは透過カバー１９に使用する素材１６の、使用する赤外線波長λに対する屈折率ｎによって決まり、使用する赤外線波長λに対する屈折率ｎが大きいほど反射ロスも大きくなる。したがって、空気（屈折率ｎａ＝１）との屈折率差が小さい界面にすれば、反射ロスが低減し、赤外線透過率ｔは向上する。図１（ｂ）に示す凹凸面４は、透過カバー１９の表面１９ａに、ある一定の寸法比からなる略正四角錐２１の凸部３を、使用する赤外線波長λに対してある一定の比のピッチＰを以って連続的に構成したものである。この凹凸面４を規定する具体的な指針としては、まず略正四角錐２１の高さＨを使用する赤外線波長λの０．１７～０．２３倍（素材１６の使用する赤外線波長λに対する屈折率ｎを１．５とした場合）の範囲内の値に設定し、次にピッチＰ（略正四角錐２１の底辺の長さＢと同値である）が使用する赤外線波長λに対して０．２～０．４λの範囲内になるようにピッチＰを決定する。このようにして規定される略正四角錐２１の凸部３を連続的に構成して形成される凹凸面４は、屈折率ｎが連続的に変化する界面となり、この界面では空気との屈折率差が漸次変化するため、反射ロスが低減し、赤外線透過率ｔを向上させることができる。尚、この効果は、実際に使用する赤外線波長λが１０μｍに対して、高さＨが２μｍで、ピッチＰが３．２μｍの略正四角錐を連続的に構成して形成される凹凸面をポリエチレン板の表面に施して試験をしたところ、この凹凸面を表面に施さない普通のポリエチレン板の赤外線透過率ｔが１６％だったのに対して、凹凸面を表面に施したポリエチレン板の方は赤外線透過率ｔが１９．５％となり、赤外線透過率ｔが３．５％向上したことによっても確認された。また、凹凸面４が曲面で形成されても同様の効果を得ることが可能である。例えば、曲面の稜線が正弦波形をしている曲面で凹凸面４を構成する場合では、正弦波の振幅が上記略正四角錐２１の高さＨに相当し、正弦波の周期が略正四角錐２１の底辺の長さＢ（＝ピッチＰ）に相当するので、ピッチＰが規定され、上記例と同じ効果を有する凹凸面４を形成することができる。また、上記例は凹凸面４を透過カバー１９の表面１９ａに施した例であるが、透過カバー１９のみに限らず、赤外線検出部２に至る光路に配設される赤外線透過部品についても表面を上記凹凸面４にすることで上記例と同じ効果を期待できる。

【００２１】このように赤外線透過部１の表面１ａに高さＨが略λ／（４ｎ$^{1/2}$）の略正四角錐２１の凸部３を０．２～０．４λのピッチＰで設けて、赤外線透過部１の表面１ａを凹凸面４にすることで、凹凸面４が、屈折率ｎが連続的に変化する界面となり、この界面では空気との屈折率差が漸次変化するため、反射ロスが低減し、赤外線透過率ｔを向上させることができ、その結果、赤外線検出部２に届く赤外線量が増え、赤外線センサーの

感度を向上させることができる。また、赤外線検出部２に届く赤外線量が増えるので、赤外線検出部２に必要な増幅器のゲインを小さくすることができ、Ｓ／Ｎ比を向上させることができる。また、上記凹凸面４からなる赤外線透過部２は、反射防止膜と同じ効果があるので、界面での多重反射によるゴースト光を抑えることができ、高感度の微動検知センサーとして用いることができる。また、赤外線透過部１である透過カバー１９の表面１９ａを凹凸面４にすることによって反射ロスを低減させるため、赤外線透過部１への真空成膜プロセス等が不要で、低コストで赤外線センサーを製造することが可能となる。尚、上記赤外線センサーの使用する赤外線波長λを５〜１５μmの範囲の赤外線とすることで、人体から放射される赤外線波長は上記波長帯域に入るので、高感度の人体検知用センサーとして用いることができる。

【００２２】次に本発明の実施の形態の他の例を図２に示す。図２は赤外線センサーの赤外線透過部１の部分断面図を示すものである。この例は、表面１ａに高さＨが略λ／（４$n^{1/2}$）、ピッチＰが０．２〜０．４λの略正四角錐２１の凸部３を設けて、表面１ａに凸部３で構成される凹凸面４（図示略）を形成するとともに、裏面１ｂにも表面１ａと同じように凸部３で構成される凹凸面４（図示略）を形成した赤外線透過部１に対して赤外線が垂直に入射する場合を示すものである。ここで赤外線が赤外線透過部１を透過する際の反射ロスとしては、入射光２２が赤外線透過部１の表面１ａに入射する際、表面反射する光（表面反射光２５とする）と、赤外線透過部１を透過する光、即ち、透過光２３が赤外線透過部１の裏面１ｂを透過する際、裏面反射する光（裏面反射光２６とする）とがある。そして、この例の場合、入射界面１ｄ及び出射界面１ｅでの反射率Ｒは共に、Ｒ＝（ｎ−１／ｎ＋１）^{2}で表せ、使用する赤外線波長に対する屈折率ｎが大きいほど反射ロスは大きいことになる。このように赤外線透過部１の表裏両面１ａ，１ｂで入射光２２及び透過光２３に上記反射率Ｒを乗じた量の反射ロスが生じることになる。そこで、本例のように赤外線透過部１の表面１ａに高さＨが略λ／（４$n^{1/2}$）、ピッチＰが０．２〜０．４λの略正四角錐２１の凸部３を設けて、表面１ａに凸部３で構成される凹凸面４を形成するとともに、赤外線透過部１の裏面１ｂにも表面１ａと同じように凸部３で構成される凹凸面４を形成することで、赤外線（入射光２２）が赤外線透過部１の表面１ａに入射する時の反射ロス及び赤外線（透過光２３）が赤外線透過部１の裏面１ｂから出射する時の反射ロスの両方を低減させることができるので、赤外線透過率ｔをさらに向上させることができ、その結果、赤外線検出部２に届く赤外線量がさらに増え、赤外線センサーの感度をより向上させることができる。尚、赤外線透過部１にポリエチレン樹脂を使用した場合、ポリエチレンの屈折率ｎは、ｎ＝１．５であるので、垂直入射に対する反射率Ｒは、Ｒ＝４％となり、入射する赤外線（入射光２２）を１００とすれば９６の赤外線が赤外線透過部１内を進行し、この９６の赤外線が赤外線透過部１内で赤外線透過部１の厚みに比例して吸収され、９６の赤外線のうち赤外線透過部１にて吸収された量を差し引いた量が赤外線透過部１の裏面１ｂに到達する赤外線（透過光２３）となり、このうちの９６％が裏面１ｂを透過して出射光２４として外部に出ることになる。

【００２３】ところで、実際の赤外線透過率ｔ´は、使用する素材の赤外線透過率ｔに使用環境における因子が影響したものとなる。特に透過カバー１９（図１を参照）の表面１９ａの汚れによる実際の赤外線透過率ｔ´の低下は赤外線センサーの感度に著しく影響を及ぼす。したがって、透過カバー１９の表面１９ａに汚れがつきにくい処理、或いは汚れを除去しやすい処理を施しておくと、透過カバー１９の表面１９ａの汚れによる実際の赤外線透過率ｔ´の低下を極力抑えることができる。特に透過カバー１９の表面１９ａに付きやすい汚れとしては、透過カバー１９の表面１９ａに水分が付着後、乾燥する際に残渣として残る汚れである。このため、赤外線透過部１の表面１ａに撥水性処理を施しておけば、赤外線透過部１の表面１ａに水分が付着してもそのまま流れ落ちてしまい、汚れが付きにくくなるので、赤外線透過率ｔ´の低下を防止することができる。

【００２４】次に本発明の実施の形態の他の例を図３に示す。この例は、表面１ａに凹凸面４が形成された赤外線透過部１の製造方法を示すものである。まず、赤外線透過部１となる、感光性及び赤外線透過性を有した素材６を用意する（図３（ａ））。次に赤外線透過性を有する均一粒径の球形微粒子５を素材６の表面６ａに一層に敷き詰めて微粒子層７を形成する（図３（ｂ））。続いて微粒子層７をレンズアレイ８として、微粒子層７の外側より素材６の表面６ａを露光する（図３（ｃ））。この時、微粒子層７を形成する個々の球形微粒子５は光をレンズのように集光するため、露光時における素材６の表面６ａの光強度分布は、均一粒径の球形微粒子５の粒径と同じピッチＰで繰り返されたものとなり、その結果、この光強度分布に対応した凹凸面４が素材６の表面６ａに形成される。尚、凹凸面４のピッチＰは使用する赤外線波長λに応じて都度変わるため、これに合わせて球形微粒子５の粒径を選定して、凹凸面４のピッチＰを適宜調節する。このように本例に示す赤外線透過部１の製造方法によれば、使用する球形微粒子５の粒径を任意に選定することにより、赤外線透過部１の表面１ａに凹凸面４を任意のピッチＰで設けることが容易にでき、また、凹凸面４の形成を一括して行うことができる。

【００２５】次に本発明の実施の形態の他の例を図４に示す。この例は、表面１ａに凹凸面４が形成された赤外線透過部１の製造方法を示すものである。まず、赤外線透過部１となる、感光性及び赤外線透過性を有した素材

６を用意する（図４（ａ））。次に赤外線透過性を有する均一粒径の球形微粒子５を素材６の表面６ａに一層に敷き詰めて微粒子層７を形成するとともに、微粒子層７の上に、裏面２７ｂに接着剤を塗布した赤外線透過性を有する透明基材２７を積層する（図４（ｂ））。続いて透明基材２７の裏面２７ｂに接着した微粒子層７をレンズアレイ８として、透明基材２７の外側より素材６の表面６ａを露光する（図４（ｃ））。これによって、図３の例と同じく露光時における素材６の表面６ａの光強度分布は、均一粒径の球形微粒子５の粒径と同じピッチＰで繰り返されたものとなり、その結果、この光強度分布に対応した凹凸面４が素材６の表面６ａに形成される。このように本例に示す赤外線透過部１の製造方法によっても、図３の例と同じ効果を期待できる。

【００２６】次に本発明の実施の形態の他の例を図５に示す。この例は、表面１ａに凹凸面４が形成された赤外線透過部１の製造方法を示すものである。まず、赤外線透過部１となる、感光性及び赤外線透過性を有した素材６を用意する（図５（ａ））。次に粒径が互いに略等しく、ある光に対して透過性を有する球形微粒子５ａと、前記光に対して吸収性を有する球形微粒子５ｂとを混合して素材６の表面６ａに一層に敷き詰めて微粒子層７を形成する（図５（ｂ））。続いて前記光で微粒子層７を通じて素材６の表面６ａを露光する（図５（ｃ））。この時、微粒子層７を形成する２種類の球形微粒子５ａ，５ｂのうち、露光に用いた光に対して透過性を有する球形微粒子５ａは、光をレンズのように集光するため、素材６の表面６ａに凹部２８を形成する一方、露光に用いた光に対して吸収性を有する球形微粒子５ｂは、光を吸収し、マスクの役割をするため、素材６の表面６ａは露光されない。この結果、素材６の表面６ａには露光に用いた光に対して透過性を有する球形微粒子５ａを配した箇所だけ凹部２８が形成されることになり、２種類の球形微粒子５ａ，５ｂが略均一に混合しているとすれば、素材６の表面６ａに凹部２８が略等ピッチで形成される。この後、微粒子層７を除去すれば、素材６の表面６ａに略規則的な凹凸面４を得ることができる（図５（ｄ））。このように本例に示す赤外線透過部１の製造方法によれば、赤外線透過部１の表面１ａに微細なマスク加工を容易に行うことができ、また、凹凸面４の形成を一括して行うことができる。

【００２７】次に本発明の実施の形態の他の例を図６に示す。この例は、表面１ａに凹凸面４が形成された赤外線透過部１の製造方法を示すものである。まず、赤外線透過部１となる、感光性及び赤外線透過性を有した素材６を用意する（図６（ａ））。次に粒径の略等しい２種類の球形微粒子５ｃ，５ｄを混合して素材６の表面６ａに一層に敷き詰めて微粒子層７を形成する（図６（ｂ））。続いて２種類の球形微粒子５ｃ，５ｄのうち、球形微粒子５ｄのみを除去する（図６（ｃ））。その後、残った球形微粒子５ｃをマスクとして素材６の表面６ａにアブレーション加工を施す（図６（ｄ））。これによって素材６の表面６ａの球形微粒子５ｃを配した箇所を除く場所には凹部２８が形成され、２種類の球形微粒子５ｃ，５ｄが略均一に混合しているとすれば、素材６の表面６ａに凹部２８が略等ピッチで形成される。この後、球形微粒子５ｃを除去すれば、素材６の表面６ａに略規則的な凹凸面４を得ることができる（図６（ｅ））。このように本例に示す赤外線透過部１の製造方法によれば、赤外線透過部１の表面１ａに微細なマスク加工を容易に行うことができ、また、凹凸面４の形成も一括して行うことができる。

【００２８】次に本発明の実施の形態の他の例を図７に示す。この例は、表面１ａに凹凸面４が形成された赤外線透過部１の製造方法を示すもので、ダイヤモンドバイト１７による精密切削加工による方法を示すものである。まず、赤外線透過部１となる、赤外線透過性を有した素材１６を用意する（図７（ａ））。次に精密切削加工の加工ピッチと加工深さを決め、これに基づいて決まる先端角度になるように研磨したダイヤモンドバイト１７を用いて、前記加工深さで素材１６を縦方向に切削し、前記加工ピッチでダイヤモンドバイト１７を順次横方向に送ることで、素材１６の表面１６ａの縦方向に幾条もの溝２９を形成する（図７（ｂ））。続いて前記加工深さで素材１６を横方向に切削し、前記加工ピッチでダイヤモンドバイト１７を順次縦方向に送ることで、素材１６の表面１６ａの横方向に幾条もの溝２９を形成することによって（図７（ｃ））、図７（ｄ）に示す略正四角錐２１の凸部３を連続的に構成して形成される凹凸面４が得られる。尚、既述の通り、略正四角錐２１の凸部３の高さＨは略$\lambda/(4n^{1/2})$とし、略正四角錐２１の凸部３を配するピッチＰは０．２～０．４λとなるようにする。このように本例に示す赤外線透過部１の製造方法によれば、赤外線透過部１の表面1ａに略正四角錐２１の凸部３を一定のピッチＰで連続的に形成できるので、凹凸面４の形成を高精度で容易に行うことができる。

【００２９】次に本発明の実施の形態の他の例を図８に示す。この例は、表面１ａに凹凸面４が形成された赤外線透過部１の製造方法を示すものである。まず、赤外線透過部１となる、赤外線透過性を有した素材１６を用意する（図８（ａ））。次にこの素材１６を加熱して軟化させた状態で均一粒径の球形微粒子１８を素材１６の表面１６ａに吹き付ける。この時、軟化した素材１６には球形微粒子１８が埋め込まれるようにして固着され、素材１６の表面１６ａが球形微粒子１８で覆われると、それ以降吹き付けた球形微粒子１８は固着されずに落下するので、素材１６の表面１６ａには固着した球形微粒子１８からなる一層の微粒子層３０が形成される（図８（ｂ））。続いてこの球形微粒子１８からなる一層の微

粒子層３０を除去すると、球形微粒子１８の外周面が転写されて凹部２８が素材１６の表面１６ａの全面に亘って形成され、これによって、素材１６の表面１６ａに凹凸面４が形成される（図８（ｃ））。尚、本例においても使用する赤外線波長λに合わせて球形微粒子１８の粒径を選定して、形成される凹凸面４のピッチＰを適宜調節することができる。また、素材１６の表面１６ａで凹凸面４が要らない部分は予めマスクしておくことで、所要の凹凸面４を形成することができる。このように本例に示す赤外線透過部１の製造方法によれば、赤外線透過部１の表面１ａに凹凸面４を任意のピッチＰで設けることが容易にでき、また、凹凸面４の形成を一括して行うことができる。

【００３０】次に本発明の実施の形態の他の例を図９に示す。この例は、表面１ａに凹凸面４が形成された赤外線透過部１の製造方法を示すものである。まず、赤外線透過部１となる、赤外線透過性を有した素材１６を用意する（図９（ａ））。次にこの素材１６の表面１６ａをレーザー４１でスキャンしながら素材１６の表面１６ａを加熱、軟化させると同時に、均一粒径の球形微粒子１８を素材１６の表面１６ａに吹き付ける（図９（ｂ））。この時、軟化した素材１６には球形微粒子１８が埋め込まれるようにして固着され、素材１６の表面１６ａが球形微粒子１８で覆われると、それ以降吹き付けた球形微粒子１８は固着されずに落下するので、素材１６の表面１６ａには固着した球形微粒子１８からなる一層の微粒子層３０が形成される（図９（ｃ））。続いてこの球形微粒子１８からなる一層の微粒子層３０を除去すると、球形微粒子１８の外周面が転写されてできた凹部２８が素材１６の表面１６ａに形成され、これによって、素材１６の表面１６ａに凹凸面４が形成される（図９（ｄ））。尚、本例においても使用する赤外線波長λに合わせて球形微粒子１８の粒径を選定して、形成される凹凸面４のピッチＰを適宜調節することができる。このように本例に示す赤外線透過部１の製造方法によれば、赤外線透過部１の表面１ａに凹凸面４を任意のピッチＰで設けることが容易にでき、また、凹凸面４の形成を一括して行うことができる。そして、凹凸面４が必要な部分だけ素材１６の表面１６ａをレーザー４１でスキャンして球形微粒子１８を吹き付ければ良いので、凹凸面４の形成を自在に行うことができる。

【００３１】尚、上記図３乃至図９の例で述べた製造方法によって赤外線透過部１の裏面１ｂにも凹凸面４を形成することができるのは明らかである。

【００３２】ところで、上述の図３乃至図９の例で示した赤外線透過部１の製造方法は全て金型を用いた成形加工によらない方法であって、本発明の赤外線透過部１の製造に金型を用いた成形加工による方法を適用しようとした場合、本発明の赤外線透過部１の表面１ａには微細な形状の加工を必要とするため、通常の金型を用いた成形加工による方法では実現が難しい。そこで、図１０に示す赤外線透過部１の製造方法は、図３乃至図９の例で示した赤外線透過部１の製造方法のいずれかによって得られた赤外線透過部１をマスター３１として（図１０（ａ））、これに電鋳を行って電鋳転写金型３２を作製し（図１０（ｂ））、この電鋳転写金型３２を金型９として赤外線透過性を有する素材１６を成形加工することで（図１０（ｃ））、表面１ａに凹凸面４が形成された赤外線透過部１を製造するものである（図１０（ｄ））。このように電鋳であれば、マスター３１の表面３１ａの凹凸面４も十分転写できるため、精密な型加工が実現でき、本発明の赤外線透過部１の表面１ａの凹凸面４の加工も可能となる。

【００３３】次に本発明の実施の形態の他の例を図１１に示す。この例は、表面１ａに凹凸面４が形成された赤外線透過部１の製造方法を示すもので、前記例が電鋳にて金型９を作製する方法であったのに対し、本例はＳｉＯ２の球形微粒子１１にて型３５を作製する方法である。まず、型枠として３次元形状の元型１２を作製し、この元型１２内にバインダーを添加した溶液１０にＳｉＯ２の球形微粒子１１を分散させた液３３を流し込む（図１１（ａ））。尚、バインダーには、例えばアルコキシシラン化合物、フルオロアルキルシラン化合物等を用いる。次に時間の経過とともにＳｉＯ２の球形微粒子１１が元型１２の底部に堆積するので（図１１（ｂ））、ＳｉＯ２の球形微粒子１１が元型１２の底部に十分に堆積した状態で、これを乾燥させ、バインダーを添加した溶液１０中のバインダーを除く液体分を蒸発させ、さらに残った堆積物１３を加熱することにより、堆積物１３中のバインダーを加水分解させて、元型１２の底部にシロキサン結合したＳｉＯ２の球形微粒子１１が固化したもの３９のみが残るようにする（図１１（ｃ））。さらに元型１２を除去すれば、ＳｉＯ２の球形微粒子１１が固化してできた型３５が出来上がる（図１１（ｄ））。この型３５を用いて赤外線透過性を有する素材１６を成形加工することで（図１１（ｅ））、表面１ａに凹凸面４が形成された赤外線透過部１を製造することができる（図１１（ｆ））。尚、より複雑な３次元形状の型３５を加工する例を図１２に示す。この例は、型３５の型枠となる３次元形状の元型１２を複雑な３次元形状をした型３５が得られるように作製したものであり、図１２（ａ）～図１２（ｆ）の各工程は図１１の例と同じである。この例にも示す通り、本例に示す赤外線透過部１の製造方法によれば、微細な凹凸面を有した複雑な形状の型の加工も容易に行うことができるため、赤外線透過部の多様な形成を可能にする。

【００３４】次に本発明の実施の形態の他の例を図１３に示す。この例は、表面１ａに凹凸面４が形成された赤外線透過部１の製造方法を示すものである。まず、図１１及び図１２の例で示した製造方法にて型３５を作製す

るとともに、赤外線透過性を有する素材１６を用意する（図１３（ａ））。次に型３５を素材１６の表面１６ａに加熱プレスすることで（図１３（ｂ））、型３５の押し付け面３６の凹凸形状が素材１６の表面１６ａに転写され、表面１ａに凹凸面４が形成された赤外線透過部１を製造することができる（図１３（ｃ））。尚、表面１ａに凹凸面４を形成する赤外線透過部１が平面で構成される場合は、押し付け面３６が平面状の型３５を用いればよいため、容易に製造することができ、また、赤外線透過部１が曲面で構成される場合でも、図１１及び図１２の例で示した製造方法において、曲面を有する元型１２を作製し、これを用いて押し付け面３６が曲面状となる型３５を作製することで、上述の方法と同じように表面１ａに凹凸面４を形成する赤外線透過部１が得られる。このように本例に示す赤外線透過部１の製造方法によれば、金型９による成形加工に比べ転写に要する時間が短くて済むため、製造サイクルを短縮でき、生産性を向上させることができる。

【００３５】次に本発明の実施の形態の他の例である、表面１ａに凹凸面４が形成された赤外線透過部１の製造方法を説明する。まず、結晶方位が（１１１）面３７にある素材１４としてシリコンウェハを用意する。次にこのシリコンウェハをＫＯＨ、ＮａＯＨ等の溶液でエッチングし、シリコンの結晶格子３４の（１１１）面３７を表出させることにより（図１４はシリコンの結晶格子３４を示す）、シリコンウェハの表面に規則正しい三角錐３８を連続的に構成して形成される凹凸面（図示せず）を得ることができる。尚、この凹凸面のピッチを制御したい場合、レジスト露光によりパターンマスクを作製する方法や、図５及び図６の例で示した製造方法を用いてもよい。続いてこのシリコンウェハをマスター３１として（以下、図１０を参照）、これに電鋳を行って電鋳転写金型３２を作製し、この電鋳転写金型３２を金型９として赤外線透過性を有する素材１６を成形加工することで、表面１ａに凹凸面４が形成された赤外線透過部１を製造することができる。このように本例に示す赤外線透過部１の製造方法によれば、規則正しい凹凸面４の形成を容易に行うことができる。

【００３６】次に本発明の実施の形態の他の例を図１５に示す。この例は、表面１ａに凹凸面４が形成された赤外線透過部１の製造方法を示すものである。まず、赤外線透過性を有するフィルム１５を用意し、これを図１０又は図１４の例で示した製造方法のいずれかによって作製される金型９にて成形加工することで、フィルム１５の表面１５ａに凹凸面４を形成する（図１５（ａ））。そして、このフィルム１５の表面１５ａが表となるように赤外線透過性を有する素材１６の表面１６ａに貼り付ける（図１５（ｂ））。これにより、表面１ａに凹凸面４が形成された赤外線透過部１を製造することができる。尚、本例では図１０又は図１４の例で示した製造方法のいずれかによって作製される金型９を用いたが、図１１及び図１２の例で示した製造方法によって作製される型３５を用いることも可能である。このように本例に示す赤外線透過部１の製造方法によれば、様々な形状の赤外線透過部１にも上記フィルム１５を貼り付けることができるので、赤外線透過部１の形状に合わせて自在に凹凸面４を形成することができ、赤外線透過率ｔを向上させることができる。

【００３７】

【発明の効果】本発明の請求項１記載の発明にあっては、赤外線透過部と赤外線検出部を備えた赤外線センサーにおいて、赤外線透過部の使用する赤外線波長に対する屈折率をｎとすると、赤外線透過部の外面に高さが使用する赤外線波長の略１／（４$n^{1/2}$）倍の凸部を、使用する赤外線波長の０．２～０．４倍のピッチで設けて、赤外線透過部の外面を凹凸面にすることで、凹凸面が、屈折率が連続的に変化する界面となり、この界面では空気との屈折率差が漸次変化するため、反射ロスが低減し、赤外線透過率を向上させることができ、その結果、赤外線検出部に届く赤外線量が増え、赤外線センサーの感度を向上させることができる。また、赤外線検出部に届く赤外線量が増えるので、赤外線検出部に必要な増幅器のゲインを小さくすることができ、Ｓ／Ｎ比を向上させることができる。また、上記凹凸面からなる赤外線透過部は、反射防止膜と同じ効果があるので、界面での多重反射によるゴースト光を抑えることができ、高感度の微動検知センサーとして用いることができる。また、赤外線透過部である透過カバーの外面を凹凸面にすることによって反射ロスを低減させるため、赤外線透過部への真空成膜プロセス等が不要で、低コストで赤外線センサーを製造することが可能となる。

【００３８】また、本発明の請求項２記載の発明にあっては、請求項１記載の発明の効果に加えて、赤外線透過部の裏面にも表面と同じように凸部を設け、赤外線透過部の表裏両面を凹凸面にすることで、赤外線が赤外線透過部の表面に入射する時の反射ロス及び赤外線が赤外線透過部の裏面から出射する時の反射ロスの両方を低減させることができるので、赤外線透過率をさらに向上させることができ、その結果、赤外線検出部に届く赤外線量がさらに増え、赤外線センサーの感度をより向上させることができる。

【００３９】また、本発明の請求項３記載の発明にあっては、請求項１又は２に記載の発明の効果に加えて、赤外線透過部の外面に撥水性処理を施すことで、赤外線透過部の表面に水分が付着してもそのまま流れ落ちてしまい、汚れを付きにくくするため、赤外線透過率の低下を防止することができる。

【００４０】また、本発明の請求項４記載の発明にあっては、請求項１乃至３のいずれかに記載の発明の効果に加えて、使用する赤外線波長を５～１５μｍの範囲の赤

外線とすることで、人体から放射される赤外線波長は上記波長帯域に入るので、高感度の人体検知用センサーとして用いることができる。

【0041】また、本発明の請求項5記載の発明にあっては、赤外線透過性を有する均一粒径の球形微粒子を感光性及び赤外線透過性を有する素材の外面に一層に敷き詰めて微粒子層を形成し、該微粒子層をレンズアレイとして、微粒子層の外側より素材の外面を露光した後、該微粒子層を除去することにより、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成することで、使用する球形微粒子の粒径を任意に選定することにより、赤外線透過部の外面に凹凸面を任意のピッチで設けることが容易にでき、また、凹凸面の形成を一括して行うことができる。

【0042】また、本発明の請求項6記載の発明にあっては、ある光に対して一方が透過性を有し、他方が吸収性を有する粒径の略等しい2種類の球形微粒子を混合して感光性及び赤外線透過性を有する素材の外面に一層に敷き詰めて微粒子層を形成し、前記光で該微粒子層を通じて素材の外面を露光した後、微粒子層を除去することにより、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成することで、赤外線透過部の外面に微細なマスク加工を容易に行うことができ、また、凹凸面の形成を一括して行うことができる。

【0043】また、本発明の請求項7記載の発明にあっては、粒径の略等しい2種類の球形微粒子を混合して感光性及び赤外線透過性を有する素材の外面に一層に敷き詰めて微粒子層を形成した後、2種類の球形微粒子のうちのいずれか一方の球形微粒子のみを除去し、残った球形微粒子をマスクとして素材の外面にアブレーション加工を施した後、残った球形微粒子を除去することにより、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成することで、赤外線透過部の外面に微細なマスク加工を容易に行うことができ、また、凹凸面の形成も一括して行うことができる。

【0044】また、本発明の請求項8記載の発明にあっては、ダイヤモンドバイトによる精密切削で赤外線透過性を有する素材の外面に凹凸面を形成することで、赤外線透過部の外面に略正四角錐の凸部を一定のピッチで連続的に形成できるので、凹凸面の形成を高精度で容易に行うことができる。

【0045】また、本発明の請求項9記載の発明にあっては、赤外線透過性を有する素材の外面を加熱して軟化させた状態で均一粒径の球形微粒子を素材の外面に吹き付けて固着させた後、該球形微粒子を除去することにより、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成することで、赤外線透過部の外面に凹凸面を任意のピッチで設けることが容易にでき、また、凹凸面の形成を一括して行うことができる。

【0046】また、本発明の請求項10記載の発明にあっては、請求項5乃至9のいずれかに記載の赤外線センサーの製造方法において製造された赤外線透過部をマスターとして凹凸面を転写した金型を作製し、該金型を用いて成形加工することにより、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成することで、直接金型を製作することが困難な場合でも、既に他の製造方法で製造された赤外線透過部をマスターとすることにより、金型を容易に加工でき、赤外線透過部の微細な凹凸面の型成形が可能となる。

【0047】また、本発明の請求項11記載の発明にあっては、3次元形状の元型を作製し、バインダを添加した溶液にＳｉＯ２の球形微粒子を分散させたものを元型内に満たしてＳｉＯ２の球形微粒子を堆積させ、これを乾燥させて残った堆積物を加熱してバインダを除去して固化させた後、元型を除去することにより型を作製し、該型を用いて赤外線透過性を有する素材を成形加工することにより、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成することで、微細な凹凸面を有した複雑な形状の型の加工も容易に行うことができるため、赤外線透過部の多様な形成を可能にする。

【0048】また、本発明の請求項12記載の発明にあっては、請求項11に記載の赤外線センサーの製造方法において作製された型を赤外線透過性を有する素材の外面に加熱プレスすることにより、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成することで、金型による成形加工に比べ転写に要する時間が短くて済むため、製造サイクルを短縮でき、生産性を向上させることができる。

【0049】また、本発明の請求項13記載の発明にあっては、赤外線透過性を有し、結晶方位が（１１１）面の素材をエッチングすることで、素材の外面に凹凸面を形成し、該素材をマスターとして凹凸面を転写した金型を作製し、該金型を用いて成形加工することにより、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成することで、規則正しい凹凸面の形成を容易に行うことができる。

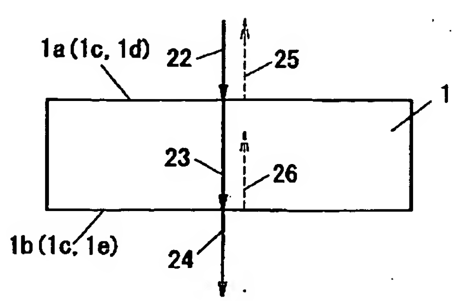
【0050】また、本発明の請求項14記載の発明にあっては、請求項10，11，13のいずれかに記載の赤外線センサーの製造方法において作製された金型或いは型にて赤外線透過性を有するフィルムを成形加工し、赤外線透過性を有する素材の外面に貼り付けることにより、赤外線検出部に至る光路に配設する赤外線透過部の外面に凹凸面を形成することで、様々な形状の赤外線透過部にも上記フィルムを貼り付けることができるので、赤外線透過部の形状に合わせて自在に凹凸面を形成することができ、赤外線透過率を向上させることができる。

【図面の簡単な説明】

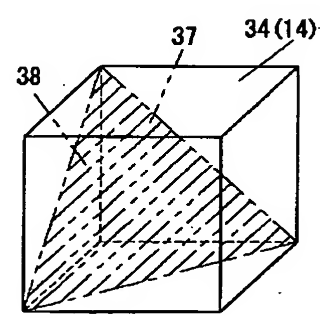
【図１】本発明の実施の形態の一例を示し、（ａ）は赤外線センサーの主要部の斜視図、（ｂ）は赤外線センサーの赤外線透過部の表面に施した凹凸面の斜視図、

（ｃ）は赤外線センサーの赤外線透過部の表面に設けた凸部の断面図である。
【図２】本発明の実施の形態の他の例を示し、赤外線センサーの赤外線透過部の部分断面図である。
【図３】本発明の実施の形態の他の例を示し、（ａ）～（ｃ）は赤外線センサーの赤外線透過部の製造工程図である。
【図４】本発明の実施の形態の他の例を示し、（ａ）～（ｃ）は赤外線センサーの赤外線透過部の製造工程図である。
【図５】本発明の実施の形態の他の例を示し、（ａ）～（ｄ）は赤外線センサーの赤外線透過部の製造工程図である。
【図６】本発明の実施の形態の他の例を示し、（ａ）～（ｅ）は赤外線センサーの赤外線透過部の製造工程図である。
【図７】本発明の実施の形態の他の例を示し、（ａ）～（ｃ）は赤外線センサーの赤外線透過部の製造工程図、（ｄ）は赤外線透過部の表面に施した凹凸面の斜視図である。
【図８】本発明の実施の形態の他の例を示し、（ａ）～（ｃ）は赤外線センサーの赤外線透過部の製造工程図である。
【図９】本発明の実施の形態の他の例を示し、（ａ）～（ｄ）は赤外線センサーの赤外線透過部の製造工程図である。
【図１０】本発明の実施の形態の他の例を示し、（ａ）～（ｄ）は赤外線センサーの赤外線透過部の製造工程図である。
【図１１】本発明の実施の形態の他の例を示し、（ａ）～（ｆ）は赤外線センサーの赤外線透過部の製造工程図である。
【図１２】本発明の実施の形態の他の例を示し、（ａ）～（ｆ）は赤外線センサーの赤外線透過部の製造工程図である。
【図１３】本発明の実施の形態の他の例を示し、（ａ）～（ｃ）は赤外線センサーの赤外線透過部の製造工程図である。
【図１４】シリコンの結晶格子を表す図である。
【図１５】本発明の実施の形態の他の例を示し、（ａ）～（ｂ）は赤外線センサーの赤外線透過部の製造工程図である。
【符号の説明】
１　赤外線透過部
１ａ　表面
１ｂ　裏面
１ｃ　外面
２　赤外線検出部
３　凸部
４　凹凸面
５　球形微粒子
５ａ　球形微粒子
５ｂ　球形微粒子
５ｃ　球形微粒子
５ｄ　球形微粒子
６　素材
６ｃ　外面
７　微粒子層
８　レンズアレイ
９　金型
１０　バインダを添加した溶液
１１　ＳｉＯ２の球形微粒子
１２　元型
１３　堆積物
１４　素材
１５　フィルム
１６　素材
１６ｃ　外面
１８　球形微粒子
２１　略正四角錐
３５　型
３７　（１１１）面
λ　赤外線波長
ｎ　使用する赤外線波長に対する屈折率
Ｈ　高さ
Ｐ　ピッチ

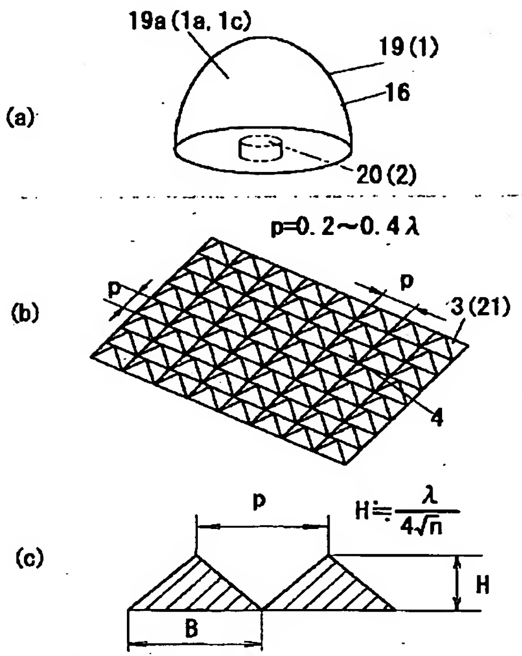
【図２】



【図１４】

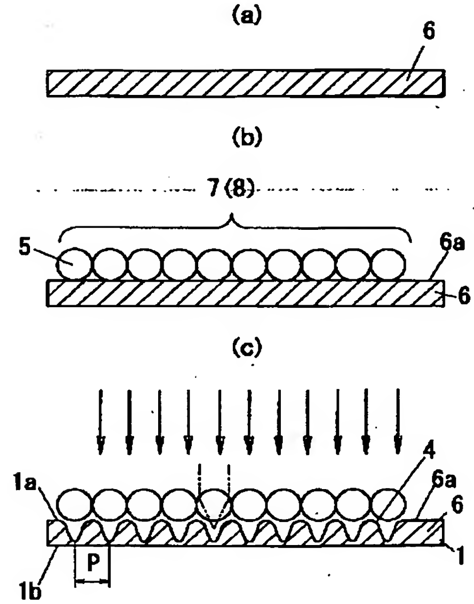


【図1】

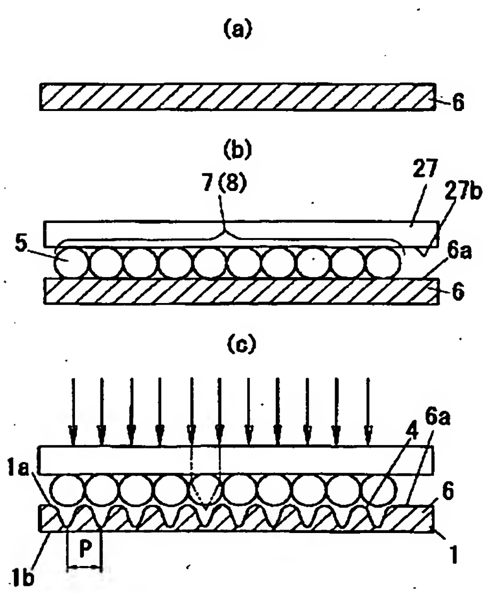


1 赤外線透視部
1a　表面
1c　外面
3　凸部
4　凹凸面
λ　赤外線波長
n　使用する赤外線波長に対する屈折率
P　ピッチ

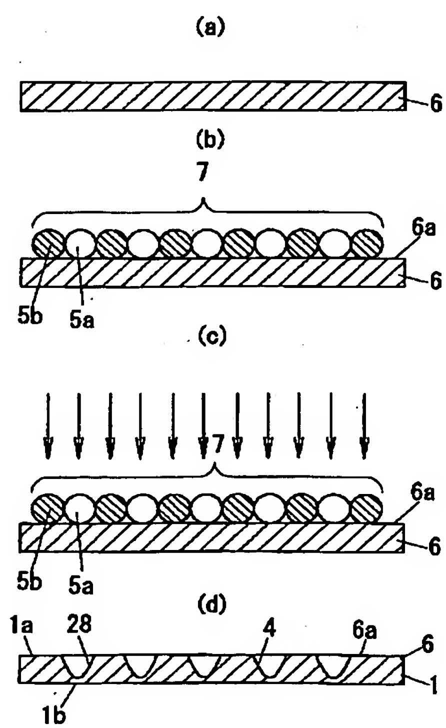
【図3】



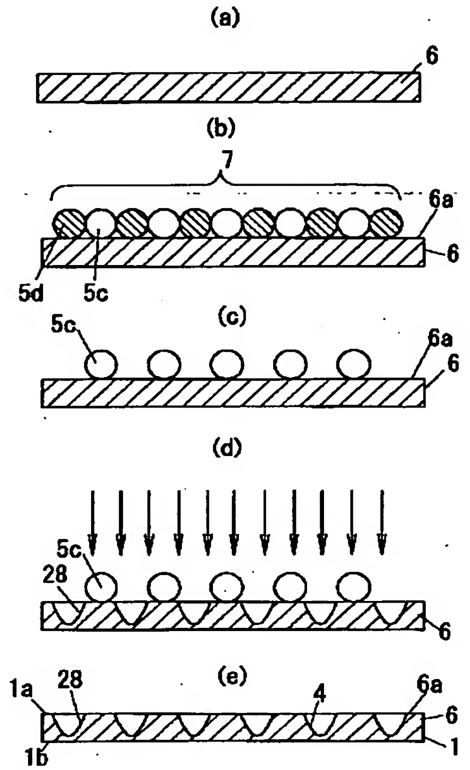
【図4】



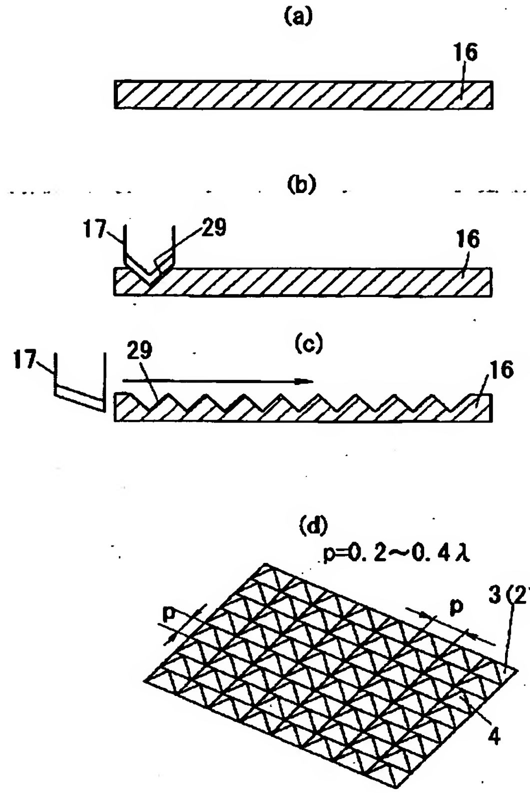
【図5】



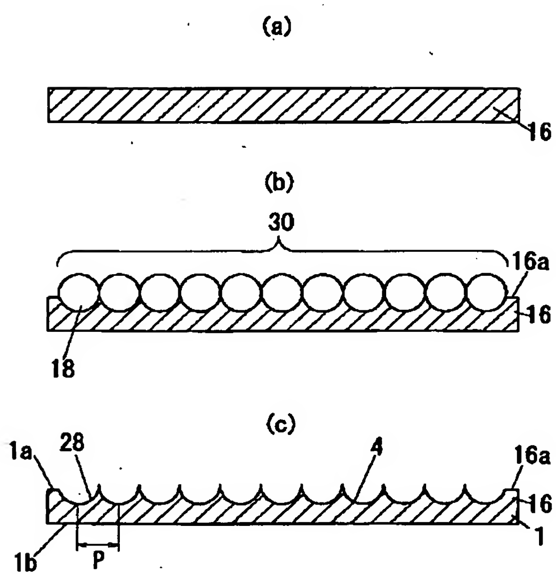
【図6】


(a)
6
(b)
7
6a
6
5d
5c
(c)
5c
6a
6
(d)
5c
28
6
(e)
1a
28
4
6a
6
1b
1

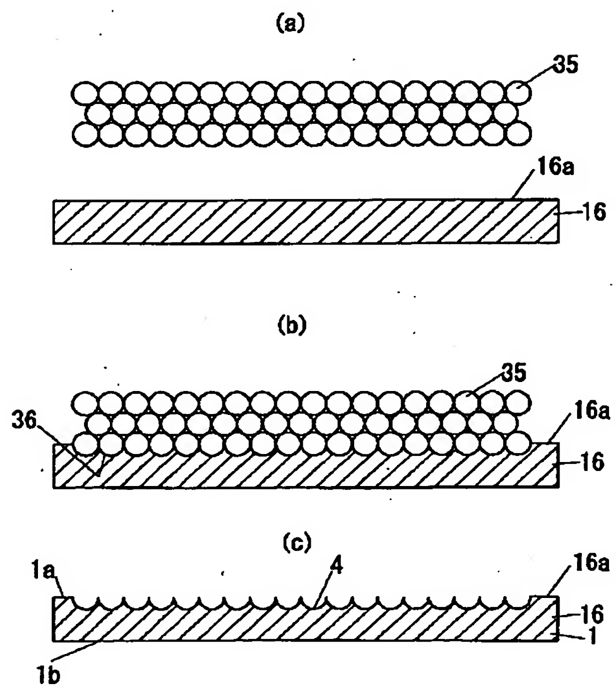
【図7】


(a)
16
(b)
17
29
16
(c)
17
29
16
(d)
p=0.2〜0.4λ
p
p
3(21)
4

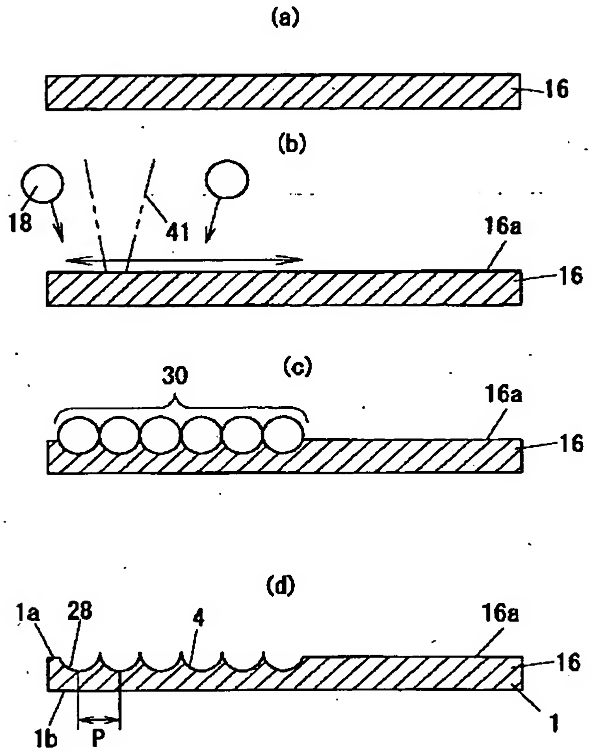
【図8】


(a)
16
(b)
30
16a
16
18
(c)
1a
28
4
16a
16
1b
P
1

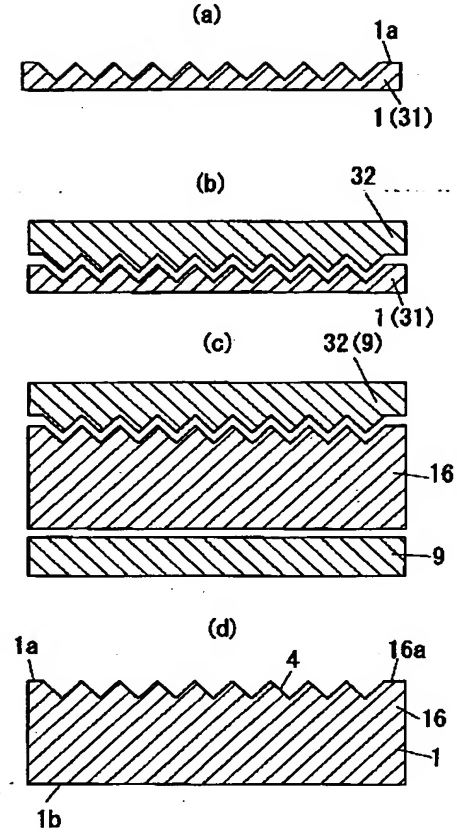
【図13】


(a)
35
16a
16
(b)
35
36
16a
16
(c)
1a
4
16a
16
1
1b

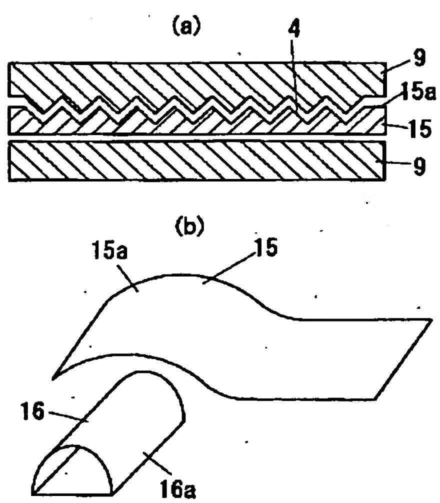
【図９】


(a)
16
(b)
18
41
16a
16
(c)
30
16a
16
(d)
1a
28
4
16a
16
1b
P
1

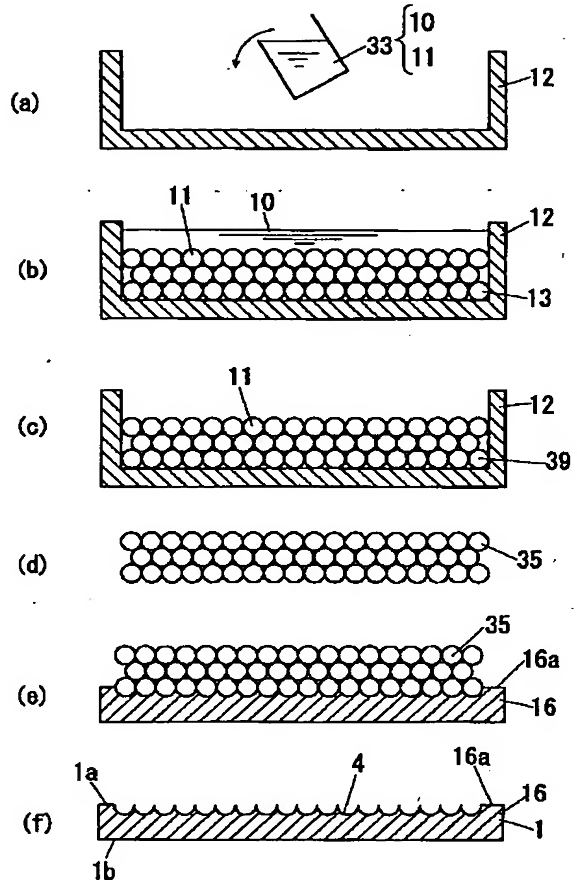
【図１０】


(a)
1a
1(31)
(b)
32
1(31)
(c)
32(9)
16
9
(d)
1a
4
16a
16
1
1b

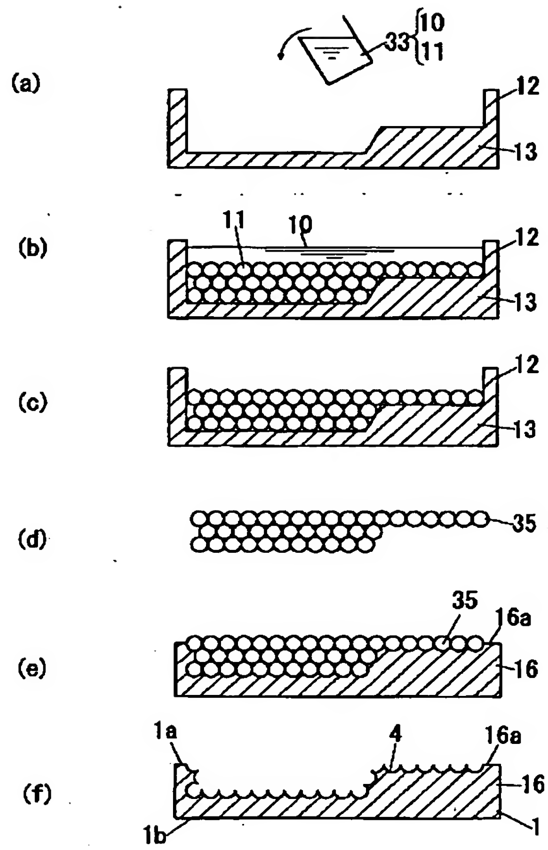
【図１５】


(a)
4
9
15a
15
9
(b)
15a
15
16
16a

【図11】



【図12】



フロントページの続き

(51) Int. Cl.^{7}	識別記号	F I		テーマコード゛(参考)
G 0 2 B 3/00		G 0 2 B	5/02	C
5/02			1/10	A

(72) 発明者 朝日 信行
大阪府門真市大字門真1048番地松下電工株式会社内

(72) 発明者 内田 雄一
大阪府門真市大字門真1048番地松下電工株式会社内

Fターム(参考) 2G065 AB02 AB03 BA14 BA37 BB06
BB09 BB19 CA03 DA20
2H042 BA03 BA05 BA12 BA15 BA16
2K009 AA12 BB24 DD05 DD15 FF02